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People and the Sound

A PLAN FOR LONG ISLAND SOUND

Supplement

New England River Basins Commission

The Long Island Sound Regional Study is a "level B water and related land resources study." It was conducted under provisions of the federal Water Resources Planning Act of 1965. The Plan which has been developed was prepared by a team of federal, state, and regional officials, local citizens, and the scientific community, under the overall coordination of the New England River Basins Commission. It is a part of the Commission's comprehensive, coordinated joint plan for the water and related land resources of its region, which includes New England and the New York portions of Long Island Sound.

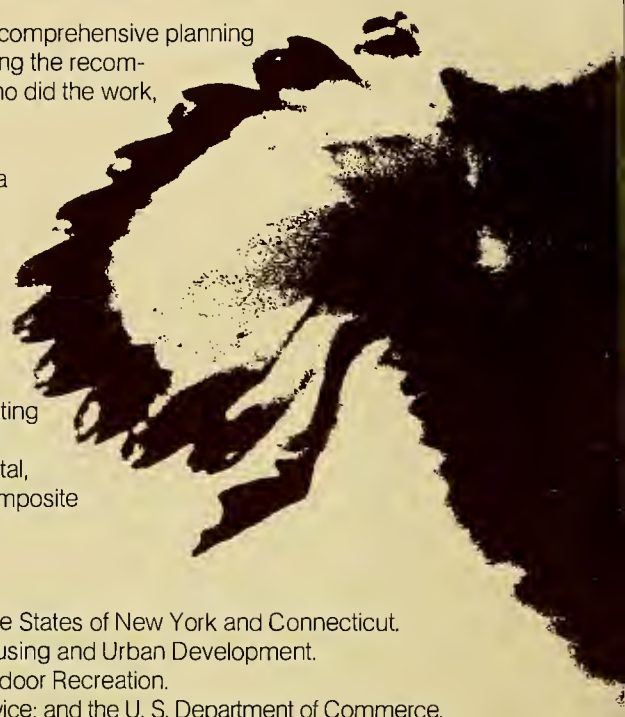
The plan for Long Island Sound recommends a program for action by federal, state, and local governments; it does not bind them to undertake specific recommended actions. To assist in the evaluation and implementation process, the following reports have been prepared:

A PLAN FOR LONG ISLAND SOUND: A SUMMARY. Highlights of the plan and a brief discussion of the rationale leading to recommendations.

A PLAN FOR LONG ISLAND SOUND: SUPPLEMENT. A more comprehensive planning document which enumerates the major alternatives considered in formulating the recommendations, together with an explanation of how the plan was prepared, who did the work, and background information organized both by subject matter and by geographical sub-regions of the Study Area.

PLANNING REPORTS. Each planning report was developed by a "Work Group," chaired by a federal agency, with the active participation of state and local agencies, other federal agencies and citizen and scientific advisors. These reports incorporate data (originally published in a series of Interim Reports) which estimate people's demands for the resources of the Sound region, the requirements needed to meet those demands, the existing capacity of the region to meet the requirements, and any deficiencies noted.

The second half of each planning report develops solutions by stating objectives in terms of satisfying defined needs, suggesting alternative ways to achieve the objective, evaluating each alternative in terms of environmental, economic, and social criteria, developing economic, environmental, and composite plans, and finally making recommendations.



The following Planning Reports were prepared:

Water Management by the U. S. Environmental Protection Agency, and the States of New York and Connecticut.

Land Use by Ralph M. Field and Associates for the U. S. Department of Housing and Urban Development.

Outdoor Recreation by the U. S. Department of the Interior, Bureau of Outdoor Recreation.

Fish and Wildlife by the U. S. Department of the Interior, Fish and Wildlife Service; and the U. S. Department of Commerce, National Marine Fisheries Service.

Shoreline Appearance and Design by the U. S. Department of the Interior, National Park Service and Roy Mann and Associates.

Marine Transportation by the U. S. Department of the Army, Corps of Engineers.

Power and the Environment by Federal Power Commission staff.

Mineral Resources and Mining by the U. S. Department of the Interior, Bureau of Mines.

Flood Damage Reduction by the U. S. Department of the Army, Corps of Engineers; and the U. S. Department of Agriculture, Soil Conservation Service.

Erosion and Sedimentation by the U. S. Department of the Army, Corps of Engineers; and the U. S. Department of Agriculture, Soil Conservation Service.

OTHER REPORTS published in conjunction with the Study are:

An Economic Perspective by the U. S. Department of Agriculture, Economic Research Service; and the U. S. Department of Commerce, Bureau of Economic Analysis. An examination of the economic and demographic trends in the region, with data for use as the basis of all projections made in the Study.

Shoreline Appearance and Design: A Planning Handbook by Roy Mann Associates, Inc., for the U. S. Department of the Interior, National Park Service. Recommended management procedures for protecting and enhancing the region's scenic resources.

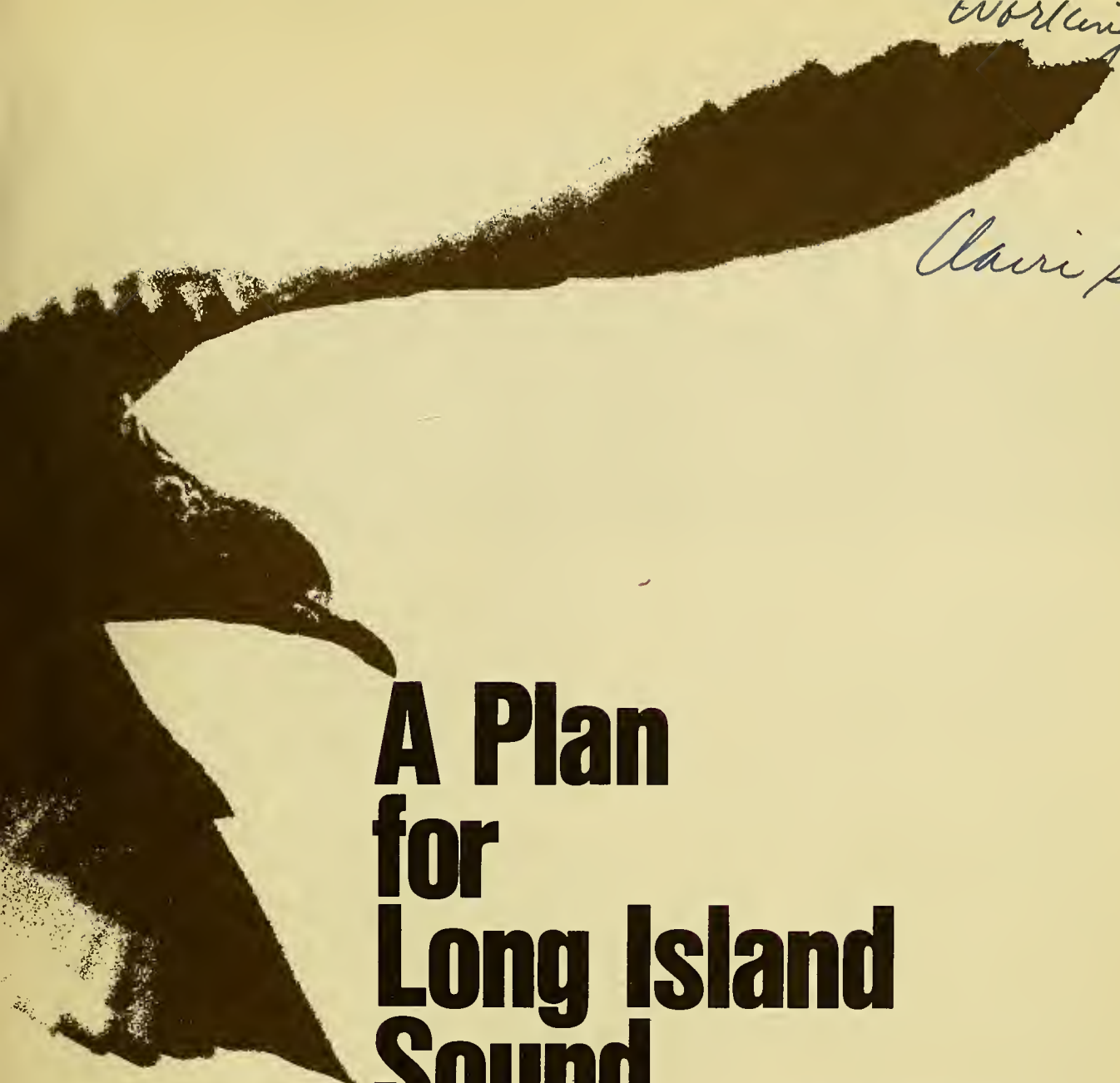
Sources and Movement of Water by the U. S. Geological Survey, Water Resources Division; and the National Oceanic and Atmospheric Administration. A summary of the hydrology and climate of the region.

Soils by the U. S. Department of Agriculture, Soil Conservation Service. An inventory and analysis of soil composition in the region.

For a complete listing of reports published by or in conjunction with the Study, see Appendix A of the Supplement. Copies of these reports are available from:

New England River Basins Commission
55 Court Street
Boston, Mass. 02108

National Technical Information Service
Springfield, Va. 22151



A Plan for Long Island Sound

Volume 2, Supplement

Final report of the Long Island Sound Regional Study, New England River Basins Commission, July, 1975.
Volume 1, Summary. Volume 2, Supplement.

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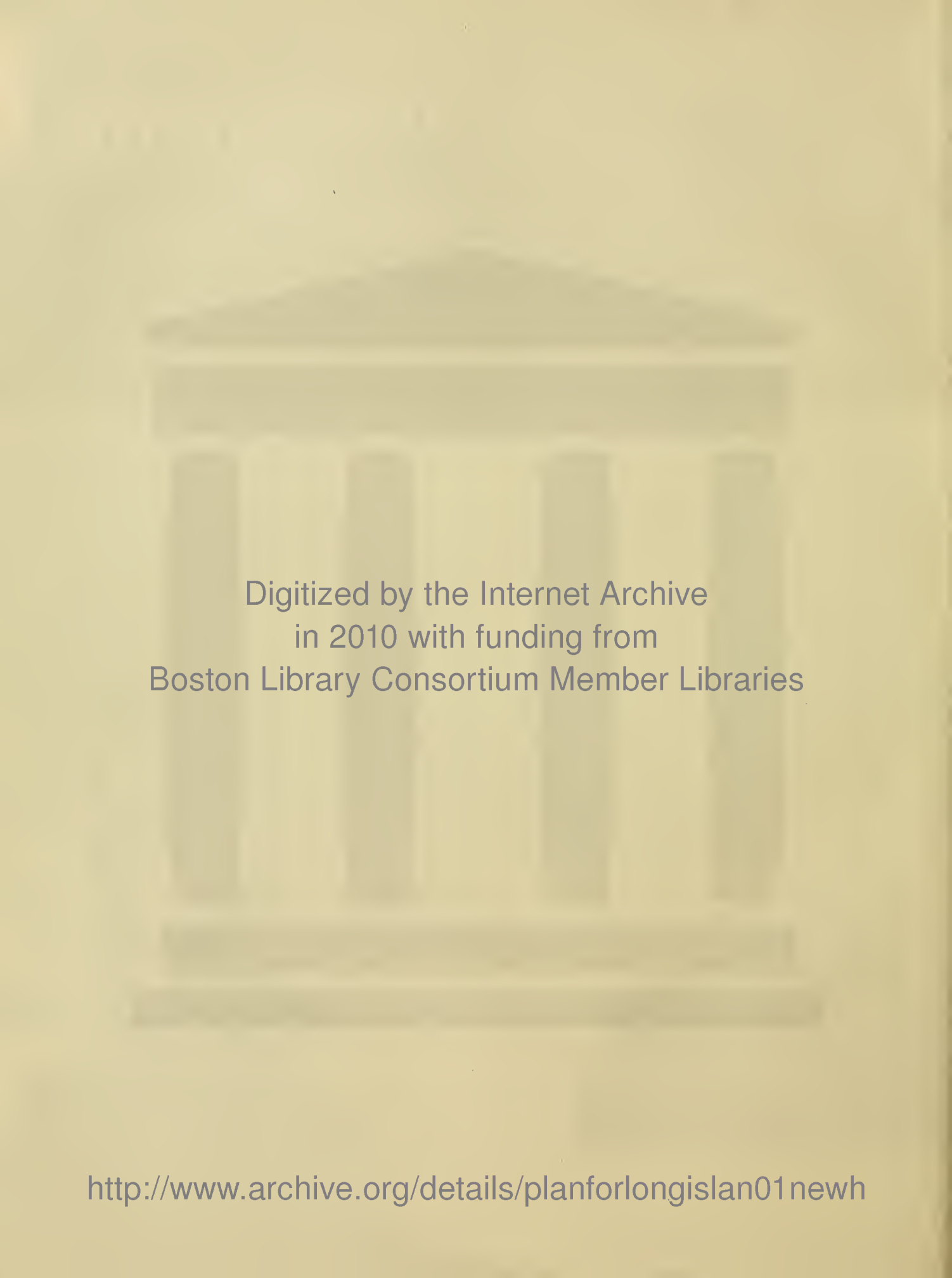
1 Preparing the Plan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Introduction

The Growth of Public Awareness

Today, public interest focuses on ten or eleven aspects or functions which together encompass people's principal relationship to Long Island Sound. These functions are given special attention in this study, especially Section Two. Each of them has existed in some form from earliest times, but it should help our own modern perspective to recall that each did not always enjoy the same prominence it does today. Precise dating of the rise of public awareness is not possible. But one can chart the general change and broadening of public interest over the years.

Before the American Revolution, public awareness of Long Island Sound and other water resources of the region was limited to their role as a convenient means of transportation and vital source of food. At about the same time, water power sites along the mainland streams began to appear and flourish. These three functions have changed greatly over the years. With the advent of first the railroad and then the automobile, shipping on the region's waterways has shifted to the movement of bulk cargo, especially petroleum products, sand, gravel, and stone. Although the commercial fishing industry in the Sound remained strong until the demise of the oyster in the 1940's, it long ago declined in importance compared to the larger, more profitable fisheries off the Grand Banks in the Atlantic Ocean. Today, the public views the fish and wildlife of the Sound almost entirely in terms of ecological, recreational, and aesthetic values, not as a significant means of sustenance. The importance of water power declined rapidly after the introduction of steam. Today, water power, although still in use, is of trivial importance. Instead, the major power concerns are environmental and economic, centering around the effects of steam electric power plants on marine life and the new power demands that may be created by our future rate and concentration of growth.

Following World War I, outdoor recreation expanded greatly to include the development of major public beaches and the rapid growth of pleasure boating. Municipal waste water disposal systems became commonplace, zoning and land use planning became more important, and significant efforts were made to control floods. But although relatively new, these latest themes have also changed. The drive to provide additional major public beaches has lost its momentum, despite the fact that swimming is by far the major outdoor public pastime. Pleasure boating has grown at such a rapid rate that much of the current public concern centers on the very large proportions of bays and coves occupied by the fleet. The removal of wastes from our homes and places of business is now taken for granted, and attention has shifted to the quality of the receiving waters, not so much because of disease, but because poor quality limits the uses of the waters. The focus of land use planning is changing, too, generally in the direction of long-range regional and comprehensive plans. Increasingly, issues are viewed as transcending local concern, with the suggestion of increasing regional and state involvement in far-reaching land use issues. The preservation of open space is now a major concept. Flood control, once dependent almost completely upon dams and flood walls to hold back the high waters, now also considers the question of whether new development should occur in the flood plains in the future and even whether some development already there might be relocated. Once primarily riverine in application, flood control programs have been expanded in recent decades to include the reduction of tidal flood damage.

In the last twenty-five years, public awareness of aesthetics, water supply, erosion and sedimentation, and minerals has grown significantly. Where once the coastline merely existed, today we think in terms of shoreline appearance and design. We want visual satisfaction, although it is still a question whether we are willing to pay for it. Once we took our supply of fresh water for granted. Now we recognize the increasing importance, especially on Long Island, of developing very long-range programs to insure a continuing supply. Erosion and sedimentation problems have always been with us, but today the very high values placed on our coastal lands for private and public use cause concern for the many acres we are physically losing to the Sound each year. Sand and gravel are so abundant in this region that limits to their availability were inconceivable several decades ago. Yet today, pre-emption of these sites

by development and very restrictive zoning ordinances threatens to create a basic minerals supply crisis.

This, in general, is a brief summary of people's shifting values. The basic relationships between people and their region's resource base were always there, but they only gained prominence individually and slowly over many years. Our recognition of the problems has grown out of the increasing demands we have made on the resource base. Our perception of the hazards of uncontrolled exploitation is recent.

What will the future bring? This study has projected people's apparent demands for the next half-century and recommended courses of action to minimize foreseeable future problems. The areas of study cover the subjects described above. No one, however, can be fully confident of future public values. A hundred thousand years ago, a worldwide shortage of caves to meet the needs of a growing population might have been perceived. But then the cave dwellers changed their values. On the other hand, the demise of the passenger pigeon could have been perceived a hundred years ago, yet modern man apparently still senses guilt at letting it happen.

To which projections of the future should we react? Which should we ignore?

History of the Study

In recognition of the growing complexity of the problems affecting Long Island Sound and of the public concern for its condition, and in response to the initiative of New York State, supported by Connecticut, the boundaries of the New England River Basins Commission (NERBC) were extended by Executive Order of the President in April, 1970, to include all of Long Island Sound and its tributary lands on Long Island (primarily the immediate northern shore). Hearings conducted in the summer of 1970 by Senator Abraham Ribicoff (D-Conn.) elicited widespread public support for the Senator's bill calling for an independent commission to conduct a major comprehensive study of the Sound, and to produce a plan for preserving the future of the Sound. Bills introduced by Congressmen Lester Wolff (D-N.Y.) and Thomas Meskill (R-Conn.), who later became Governor of Connecticut, also advocated such a study. During the course of the 1970 hearings, it became apparent that NERBC had the authority and geographic coverage to perform the study. Acting from this wide base of public, Congressional, and state support, the U.S. Water Resources Council designated NERBC to conduct this comprehensive study in concert with its appropriate members—the two states and several federal agencies. Officially, the study began on July 1, 1971. In April of the next year, NERBC established its New Haven office with a small staff at 270 Orange Street.

Because of funding delays, however, the study could not get under way in full force until late in 1972. The following summer, a number of public workshops were conducted throughout the region to assess public attitudes toward selected major issues. Throughout the fall and winter of 1973, the study released a series of interim reports summarizing inventory data and anticipated needs of its major elements. In March, 1974, the study widely distributed a brochure setting forth a preliminary assessment of the region's problems, possible alternatives, and tentative recommendations to meet them. It also contained a second questionnaire. The brochure and the follow up series of public meetings and questionnaire responses were given intensive coverage by the press.

In August and November, 1974, the study issued successive and evolving drafts of this report, the latter for simultaneous "official" review by the more than 250 study participants, many local and regional officials, conservation groups, and other interested parties. In early December, 10,000 copies of a brochure were distributed containing the summary and recommendations of the final Draft Plan. This, combined with extensive press coverage, helped to draw more than 1,000 interested citizens to the third, and final, set of public meetings, held in eleven locations in January, 1975.

The final report was then modified and submitted in the spring of 1975 to the governors of the two states and the U.S. Water Resources Council for their review and the latter's transmittal to the President and Congress.

From here on, action rests with the public. Although the two states and the major federal agencies generally support the study recommendations, and have most of the authority to implement them, they can only do so if the recommendations are given sufficient priority and funds. These two ingredients are products of public support. Without that continued strong support, the actions proposed in this plan will not come to pass.

Purpose

The goal of the study itself is to produce a plan of action by June, 1975, which balances the needs to protect, conserve, and wisely develop the Sound and its related shorelands as a major economic and life-enriching resource for the 12 million people who live near it.

The study has created a process whereby objectives are coherently developed and their consequences identified in order that coordinated and imaginative solutions to pressing problems can be set forth. The process should continue long after the study is completed, allowing it to be adapted as conditions and needs change over time.

Although the study's recommendations are advisory, they are intended to lead to action by private, local, state, and federal interests to solve specific problems and realize specific opportunities. The study is expected to serve as a guide leading to authorization studies and funding, through customary channels, for action projects by all appropriate federal and state agencies. It is to provide guidance for administration of federal and state grant-in-aid programs,

and should help guide community and regional action programs as well.

Scope

The scope of the study is defined in terms of the following consistent themes which governed its preparation:

It emphasizes water and directly related land uses. Since the greatest emphasis is placed on the Sound, its shoreline, and its tributaries, detail wanes somewhat as one moves inland. Although everything is in some way related to water, a hard line was adopted against extending the study in ever widening circles. For example, treatment of land use and transportation is intended to be limited primarily to their water-related aspects.

It is comprehensive. It addresses all the principal water-related uses, for all parts of the Sound, for all levels of government, and the private sector.

It is long range. It not only considers current conditions, but also attempts to anticipate conditions, problems, and solutions for the benchmark years of 1990 and 2020. Recommendations for 1990 are generally conservative in that they are based upon existing technology, while those beyond that date become more innovative by incorporating an increasing amount of technological prediction.

It is multi-agency. Connecticut, New York, nine federal agencies, four regional agencies, citizen and scientific advisory committees participated prominently in the preparation and review of the study under the direction of the New England River Basins Commission, a federal-state organization.

It is public-oriented. Content was strongly influenced by the Citizen Advisory Committee, by responses to two questionnaires, by three separate rounds of public hearings or workshops—before, during, and near the end of the study—with about forty sessions and 3,000 interested attendees, and by response to the interim reports, newsletters, and press releases issued throughout the life of the study.

It is balanced. Every recommendation has been evaluated in terms of stated criteria that define an environmental, an economic, and a social well-being point of view. Wherever judged feasible, accommodation was sought, even if it meant settling for what appeared to be a "second best solution" when evaluated from only one of the three viewpoints. In the surprisingly few cases in which accommodation was not feasible, individual recommendations were chosen between the viewpoints; but collectively, these choices were still balanced—i.e., they did not significantly favor one of the viewpoints consistently above the others.

It is coordinated. Every recommendation has been checked against all others to promote consistency and reinforcement. A common interest rate, constant (1970) dollars (where possible), uniform explicit evaluation criteria, parallel formats, and uniform benchmark years have been used throughout. The published Principals and Standards of the U.S. Water Resources Council governed all parts of the study.

It is broad. Principal emphasis was placed on policies and programs for the region as a whole. Although numerous site-specific proposals are provided, based upon conditions within each subregion and throughout the region as a whole, they necessarily had to be given secondary attention. It was assumed that local government would be particularly interested, and more able than the study team, to tailor site-specific proposals to fit local conditions and preferences.

It is neutral with respect to growth, per se. The study team heard a widespread preference of those now well-established in the region (and in adjacent regions) for suppressing future growth. However, the study team also accepted the well-documented conclusion that, in water abundant areas such as the East Coast of the United States, success or failure in achieving water resources goals has little effect, of itself, on the rate of growth. Furthermore, the study felt that the adoption of growth and no-growth philosophies should be established in the economic, social, and political arenas, where the consequences of either philosophy would most prominently be felt. Whatever the conclusions of such an evaluation, the study felt that growth should be controlled directly, rather than by using water resources as a surrogate. In this study, therefore, emphasis was placed, not on limiting or advocating growth itself, but upon limiting the environmental consequences of growth.

It is based upon existing knowledge. The study is based upon a review and application of existing knowledge. Additional field surveys and research were not conducted. Inclinations to postpone recommendations until, somehow, more research was accomplished were generally resisted, based on the conclusion that no decision is indeed a decision. In cases of doubt, the general tendency was to recommend reversible action coupled with research so as to permit adjustments to be made as new knowledge emerged.

It is an environmentally and economically conscious response to people's apparent needs. In each of ten major functions, the approach was:

1. Describe people's wants, as best they can be deduced from listening to people and, more importantly, by observing what people actually do.
2. Translate these wants into requirements placed upon the region's resource base.
3. Compare these requirements with the region's current capacity to satisfy them, and thereby define potential problems in terms of unfulfilled needs.
4. Examine alternative ways of meeting these needs, and the environmental, economic, and social impacts of doing so.
5. Tentatively recommend what appear to be tradeoff positions, including not meeting the needs, and seek public response.
6. Revise to more closely match public reaction, while recognizing that no strong recommendation can ever please everyone.

Description of the Region

A region such as the Long Island Sound area can be characterized using a variety of physical and human dimensions. One goal of the planning process is to identify how these various dimensions interact and to identify problems and possible solutions associated with this interaction.

Physical dimensions discussed below include study region boundaries, geology, climate, water, and marine life. They form the natural framework for man's activities here.

The human dimensions include population, the economy, and the structure of government for natural resource planning activities.

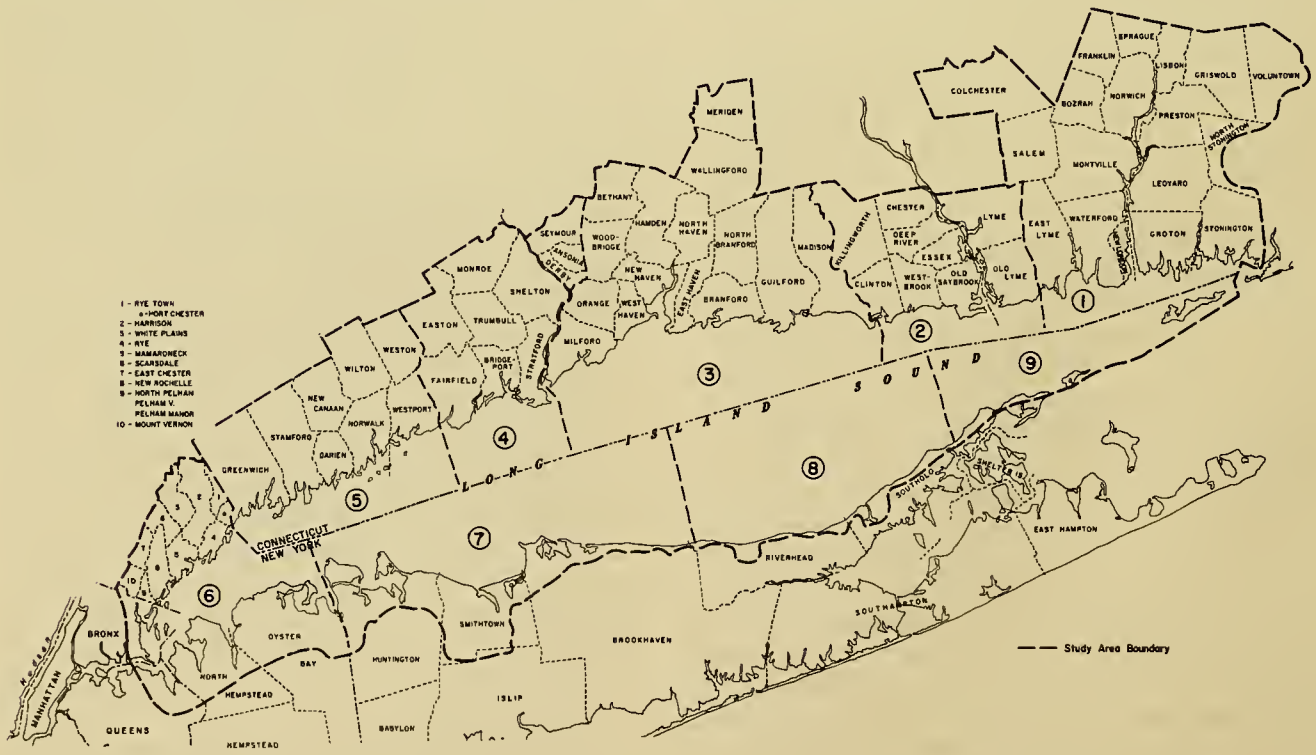
Physical Dimensions

Boundaries. Figure 1.2-1 traces the boundaries of the study region and the subregions into which it was divided for study purposes.

In Connecticut, subregion boundaries are generally coterminus with boundaries of regional planning agencies (RPAs), which in turn follow town lines for administrative reasons. The alignment is as follows:

Subregion 1 – Southeastern Connecticut RPA
Subregion 2 – Connecticut River Estuary RPA

FIGURE 1.2-1 Boundaries of the Study Region



Subregion 3 – South Central Connecticut RPA
Subregion 4 – Greater Bridgeport RPA and Lower Housatonic Valley RPA
Subregion 5 – Southwestern Connecticut RPA

In New York, the boundaries of the study follow the surface drainage divide. In Westchester, the divide happens to fall roughly along town lines. The divide then traces a line southward through the Bronx to the Whitestone Bridge into Queens. In Nassau and Suffolk, the study boundary must follow the surface divide, by Executive Order of the President.

Contiguous with the eastern edge of the study region and encompassing a small piece of Connecticut, all of Rhode Island and much of eastern Massachusetts is the region currently being analyzed in the Southeastern New England Regional Study (SENE). North of the study area and encompassing the Connecticut River Valley extending up to Canada is the region currently being analyzed in the Connecticut River Supplemental Study (CRSS). The SENE Study and the CRSS are sister studies to the Long Island Sound Regional Study. All three are components of NERBC's Coordinated Comprehensive Joint Plan.

Notwithstanding its boundaries, the study has adopted a flexible approach. Emphasis is on the demand for the resources which lie inside the boundaries. Depending upon the function, demand may stem entirely from within the study region (as demand for beach erosion control) or come from market areas far beyond the study region (as demand for electric power). Frequently, in order to avoid tedious and unrewarding computations, county-wide socio-economic data were used to describe the areas from which the heaviest users of the study region's resources come.

Land. Long Island Sound and the land around it took on its present appearance during the last Ice Age. Long Island was the southernmost limit of the glaciers.

The island's drainage characteristics, its 300-foot north shore moraines, its gentle slope southward, and its surficial deposits of sand and gravel, up to 600 feet thick, are all products of the retreating glacier.

The terminal moraines on Long Island alternate with sands and gravels of outwash origin. The sand and gravel deposits in turn overlie thick coastal plain sediments interspersed with lenses of clay.

The Connecticut shore, with its mixture of rock-bound coast, sandy beaches, and low-lying hills, was shaped both by erosion and the deposition of materials as the glacier advanced and retreated, after which the Sound filled with water.

Unconsolidated glacial deposits discontinuously mantle the land surface in Connecticut and Westchester County. The river valleys are filled with stratified-drift deposits that vary from lake-bottom silts and clays to coarse gravels. In the upland areas the dominant surficial material is till, a generally compact mixture of sand, gravel, silt and clay. Bedrock is usually more than ten feet deep throughout the area but rock exposures are common in the uplands. The bedrock generally consists of granite, gneiss, and schist except in subregion 3 where basalt, sandstone, shale, and conglomerate occur.

The nature of the Sound's coastline is determined by a complex interplay of forces. Glaciation, changes in sea level, ocean currents, waves, and biologic processes have all helped to shape the coastline.

The Connecticut coast is very irregular with many bays, coves and promontories. About half of the 275 mile shoreline consists of beaches; the remainder is rock-bound or wetlands. Except where artifically widened by man, the beaches are narrow and sometimes stony. They provide poor protection to the backshore and inadequate space for mass beach recreation.

TABLE 1.2-1 Length (in Miles) of Coastline and Beaches

Subregion	Coastline Length[a]	Beach Length[b]
CONNECTICUT:		
Subregion 1	79	24
Subregion 2	31	21
Subregion 3	58	50
Subregion 4	30	21
Subregion 5	75	26
Subtotal	273	142
NEW YORK:		
Subregion 6a	35	8
Subregion 6b	25	11
Subregion 6c	62	5
Subregion 7	112	30
Subregion 8	33	26
Subregion 9	37	40
Subtotal	304	120
TOTAL	577	262

a. Coastline length increases greatly with the detail with which coastal configurations are measured, particularly in estuaries such as those of the Connecticut and Thames Rivers. Lengths were measured by the Commission staff on USGS 7½' Quadrangles, going up major rivers and estuaries, generally to the first bridge.

b. Beach lengths were taken from the National Shoreline Study, U.S. Army Corps of Engineers.

Irregularity is also the dominant characteristic of the coastline of Westchester County and the western half of the Long Island coast. Eastward, the coast becomes exceptionally regular with no significant indentations. Along the entire North Shore of Long Island, the beaches are generally narrow and rocky or pebbly, except where people have added or trapped sand as at Sunken Meadow. The beaches usually front high bluffs or small marshes. Large wetlands are uncommon except at the heads of a few embayments.

There are 129 islands in the Sound, counting 3 in the East River and 126 along the Connecticut coast. They range

from small outcroppings to wooded and settled islands with dwellings. Large shoals lie off Stratford and Old Saybrook.

Climate. The climate of the Long Island Sound Region is characterized by four distinct seasons, little monthly variation in normal precipitation, marked temperature contrasts over short distances, and a maritime influence which modifies air masses entering the region.

Mean annual temperatures range from 49° to 55°F, the highest occurring in western and central Long Island. Average annual precipitation ranges from about thirty-six inches over the Sound to fifty-one inches in some elevated areas. Over the past 100 years, sixteen tropical storms or hurricanes have passed directly over the study region and forty-seven others have passed within 150 miles of the region.

The climate of the Sound is responsible for many conditions and events that are important to people and planning. This region, for example, is occasionally subject to disasterous floods, hurricanes, and droughts. The frequency and magnitude of these events require planning for flood protection and for adequate water supply. Precipitation, temperature, and humidity conditions influence agriculture and determine energy requirements for heating and air conditioning. Other extreme weather events, such as tornadoes, are rare near the Sound because of the stabilizing effect of this water body on air currents.

For example, the modification of the climate of the region caused by the Sound means that there are somewhat fewer days of extreme cold when peak demand for electricity or other energy needs of the region may be exceptionally high. In late spring and summer, water temperatures are cooler than air temperatures and in late autumn and winter, water temperatures are generally warmer than air temperatures (leading to extended swimming seasons). The Sound produces a longer growing season along its shore even though the cooler ocean waters in early spring retard the growing season.

Water. The study region enjoys an abundant supply of fresh water derived from precipitation and from inflowing streams. Of the total precipitation falling on the land during the course of a year, about half (nearly all in the summer, hardly any in the winter) returns to the atmosphere by evaporation or transpiration. The remaining half ultimately reaches the Sound by surface or subsurface flow. On the mainland, the principal flow path is along the surface, while subsurface flow predominates on Long Island.

Some seventy-five streams draining about 16,000 square miles flow into the Sound. Only 12 percent of this drainage area, however, is within the study region. The Connecticut and the Thames Rivers account for over 80 percent of the total streamflow entering the Sound. Inflow averages 26,200 cubic feet per second and is highest in the spring and lowest in the summer. Tidal effects extend various distances upstream on the rivers entering the Sound (to above Hartford on the Connecticut River and Norwich on the Thames River).

On Long Island, surface runoff is minor. The dominant flow path there is rapid downward percolation to the water table and then slow movement toward salt water, mostly south toward the ocean.

Ground water supplies in the region are abundant. Long Island is underlain by a large ground water reservoir of generally good quality. It meets almost all the Island's fresh water needs. The fresh ground water beneath Long Island is hydraulically connected with salty ground water near the shore. The yield of the fresh ground water reservoir is not a single fixed quantity; it will vary depending on hydrogeologic conditions, the management scheme, and the extent to which undesirable effects of development will be tolerated. The mainland on the north shore of the Sound—with its deposits of sand, gravel, silt and clay (stratified drift and till), and bedrock—contains many hydrologically separate ground water reservoirs of generally good quality. Large quantities of ground water may be pumped from wells tapping stratified-drift deposits whereas most individual domestic wells obtain adequate water from bedrock.

The several ways water enters and leaves the study region are depicted and quantified in Figure 1.2-2. The figure shows that water enters from (1) precipitation falling directly upon the region's land and its water bodies, (2) as runoff from adjacent land areas that drain into the Sound, (3) from Block Island Sound to the east and the East River to the west, and (4) from sewage treatment plants that process water from outside of the Long Island Sound drainage area. Water leaves the region by (1) evaporation and transpiration into the atmosphere or (2) by outflow into Block Island Sound and perhaps into New York Harbor.

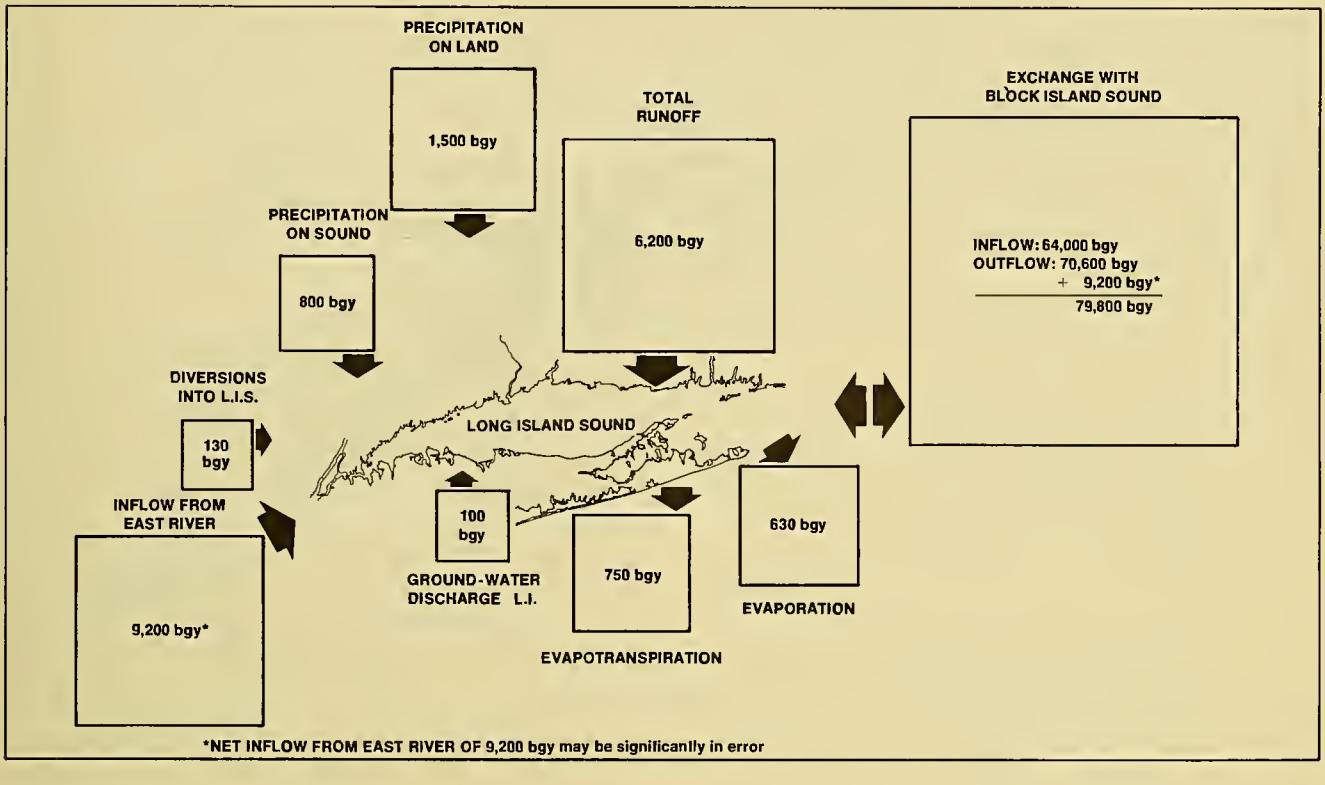
Long Island Sound itself is a 1,300-square-mile body of salt water, 113 miles long and 21 miles wide at its widest point. It has depths up to 320 feet, but the average depth is 80 feet. Surface water temperature varies over the year from 32° to 73°F. Salinity varies widely, from 23 parts per thousand (i.e. 2.3 percent) in some estuaries to near 35 parts per thousand near the open ocean.

The Sound displays estuarine characteristics in its western and central parts and embayment characteristics in its eastern third. The minimum tidal range and maximum tidal currents occur at the eastern end and the maximum tidal range and minimum tidal currents at the western end. Circulation is controlled principally by tidal currents modified by fresh water inflow, weather conditions, and topography. The circulation pattern of surface and near surface waters is fairly well defined, but relatively little is known about deep current circulation. Surface tidal current patterns in the central and eastern Sound are elliptical and counter-clock-wise in direction. At the eastern end, surface water flows out of the Sound into Block Island Sound, while more dense and saline bottom waters flow into Long Island Sound. At the western end, surface water from the East River flows into the Sound and bottom waters move into the East River. Lack of quantified information on inflows and outflows in the western end of the Sound is a major gap in knowledge necessary to understand and manage the Sound.

The Sound has been classified as a moderately stratified

FIGURE 1.2-2 Water Circulation in Long Island Sound

General pattern of water circulation and estimated average quantities of water involved in billions of gallons per year (bgy). The blocks are drawn to scale. For further comparison, the volume of water in the Sound at mean low water is about 16,800 billion gallons.



estuary in that ocean waters and fresh waters do not mix completely. The well-oxygenated, cold, dense, marine waters remain unmixed below the surface throughout a large area of the eastern Sound. The less-oxygenated, warmer, lighter, fresh water enters mostly in the eastern end from the Connecticut and Thames Rivers, remains near the surface and is flushed out to sea rather rapidly, thus producing minimal salinity dilution. This physical two-layer movement system influences the Sound's chemical regime. It tends to flush out to sea the lighter suspended pollutants from inland sources and to bring up nutrient-rich waters from the bottom.

Marine life. Biologically, Long Island Sound, like an estuary, is a region of transition. To survive and successfully reproduce in an estuary, an organism must be adaptable to a wider range of environmental stresses than those encountered in a strictly marine or fresh water environment. A wide combination of factors determines the distribution of estuarine organisms. This extreme cyclic variation of environmental factors is a permanent feature of the estuarine environment. The organisms that have become adapted to this environment must tolerate the extremes and may even require them.

Typical of estuaries, the marine fauna and flora of the Sound display a greater density of individuals but fewer species than are found in the open sea. The concentration of non-living particulate organic matter in the Sound is generally greater than the concentration of living phytoplankton. Light penetration is limited to thirty feet or less in certain parts of the Sound. The lack of sunlight may limit algal growth below this depth, but surface growth is rapid because there is enough tidal mixing to recycle nutrients from the bottom.

Tidal wetlands, flats, and shallows contribute to the overall functioning of the ecosystem in several ways: as habitat; as contributors to the food chain; as pollution filters; as sediment traps; and as heavy metal sinks. They provide the principal habitat for wildlife and for most of the marine animal species of the Sound during certain stages in their life cycles. They are important as spawning areas, as nursery areas for juvenile stages, and as feeding areas for adult species. Tidal wetlands, flats, and shallows support the primary producers which in turn support a variety of higher forms.

Several key points can be made about biological productivity in the Sound:

(1) At the primary trophic level, the Sound is highly productive. With its abundant supply of nutrients, it compares favorably with the most productive of marine areas, the salt marsh. Given the nutrient supply, primary productivity is related principally to changes in light and temperature. Therefore, most primary production in the Sound

occurs in the upper thirty feet.

(2) At the herbivore level, productivity and standing crop drop rapidly, although the productivity level is still fairly high. While the zooplankton are abundant and productive, it appears that the most abundant zooplankton organisms are not as efficient in their feeding, and may consume only about one-quarter of the primary production available to them. Zooplankton organisms are in direct competition with benthic filter feeders and, to a certain degree, detrital feeders. The water column also contains a high level of bacteria and ultraplankton. Some of the ultraplankton and nannoplankton organisms may be unavailable to the filtering apparatus of the most common zooplankton organisms in the Sound. Also, the more efficient and valuable marine zooplankton such as *Calanus finmarchicus* and *Centropages typicus* are generally excluded from the Sound, except at the extreme eastern end.

(3) At the carnivore level, it appears that a number of finfish, including the flounder, depend directly on the Sound's rich supply of benthic fauna. On the Sound's bottom, as in any aquatic environment, the single cell bacteria, protozoa, and other forms of microbenthos are more numerous as individuals, but as biomass they often constitute a small portion of the standing stock. Other small organisms, such as nematodes and copepods, form the meiobenthos. These small microbenthic and meiobenthic organisms form the base of the food chain, which includes worms, small snails and clams, and other species which ultimately terminate in the finfish. Molluscan shellfish, however, are of uncertain value to finfish, although in their juvenile stages they provide a source of food for bottom feeding finfish. The Sound bottom has ideal conditions for shellfish growth and for a number of worms and suspension and/or deposit feeding invertebrate animals, available to other carnivores as food.

Looking at the Sound as a dynamic trophic system rather than as a static one, it is necessary to consider its nutrient reserves, their origin, input, circulation, and regeneration. Phosphate and nitrate, for example, are necessary for rapid phytoplankton growth, and small amounts may be enough to stimulate rapid production. The Sound system, being estuarine, is already a very fertile and productive area because the sea water contains a considerable balance of fertilizing elements essential for phytoplankton growth. Also, the Sound is an area of major fresh water inflow, particularly along the Connecticut shore, with a measurable nutrient input from the human environment.

Human Dimensions

Human dimensions or characteristics describing the people for whom planning is undertaken, are numerous. Those highlighted below include population, the economy, and the structure of government as it relates to resource planning. As a tool to help do this, the study employs the latest baseline projections, OBERS Series E (for Office of Business Economics-Economic Research Service. Office of Business Economics is now Bureau of Economic Analysis). Other projections, which can be useful for less comprehensive purposes, are discussed in Section 1.4 along with the study methodology. The OBERS Projections are a best current estimate of what can be expected to materialize *if* there are no major changes of an unusual and unforseen nature or magnitude in the factors which determined past trends. The projections are in no sense a goal, an assigned share, or a constraint on a region's economic activity, nor do they carry any connotation as to desirability or undesirability. Especially, they should not constrain the planner in considering alternative levels of growth, if those levels can be achieved through planning.

As stated more completely in the previous section, the study is neutral with respect to growth per se. Neither growth nor no growth is actively promoted. It has been rather well established that, in water abundant areas such as this, satisfaction or non-satisfaction of most water-related demands will not have a major impact on growth. Other economic, political, social and legal factors exert the dominant effect.

Population. The study region is situated in the middle of an evolving constellation of urban centers ranging from Boston to Norfolk, sometimes called the Northeast Megalopolis or the Atlantic Seaboard Metropolitan Belt. About one-fifth of the nation's population is expected to live in this belt by the end of the century.

Figure 1.2-3 shows the current and anticipated population densities in the northeastern United States. From this figure, it is easy to see the pressure placed upon Long Island Sound compared to those placed upon other major East Coast estuaries such as Chesapeake Bay and Delaware Bay. In 1970, 13.2 million people were living in the seven counties bordering the Sound and in contiguous New York City. That is about as many as live in the half of the United States lying west of Texas, excluding the State of California. It seems clear that population pressures on coastal resources are greater here than in any similar sized coastal reach in the nation.

New York City itself, like most of the nation's metropolitan cores, has stopped growing, but population growth in the seven-county area has been about twice the national average since 1940. Growth was especially rapid in Nassau County between 1940 and 1960 and in Suffolk County between 1950 and 1970. Both these large increases reflect the movement of people away from New York City and from outside the region to the suburbs on Long Island.

The OBERS Series E projections of future populations used in this study are based upon historical trends in economic and demographic relationships and are consistent with national totals. They assume an early saturation of Nassau and southern Westchester, forcing growth to the outer suburbs of New York City.

In the absence of unprecedented policy changes by public decision makers, these projections show that the rate of population growth in the seven-county area will drop sharp-

FIGURE 1.2-3 Atlantic Metropolitan Region

ly in the future, to well under half the 1960-1970 rate. Contributing to this lower rate are (1) the national pattern of fewer children per woman which will approach 2.1 by the year 2000, (2) the region's decline in earnings per worker relative to the U.S. average, and (3) a net out-migration of persons forty-five and older, perhaps because of better climate and lower living costs in other parts of the nation.

Because of the availibility of land, well over half of the projected 1970-2020 growth is in Suffolk County. The county is expected to triple its current population. The rest of the seven-county region should grow at about the national rate, with the faster growth occuring in Middlesex and Fairfield Counties and slower growth occurring in Nassau and Westchester.

Table 1.2-2 summarizes historical and projected populations and growth rates for the seven counties and offers comparisons with other regions. Further details on population projections of the study are contained in a special LISS report, *An Economic Perspective*, July, 1974.

Economy. The region is an unusually affluent one. Connecticut and New York rank first and third among the fifty states in terms of per capita income. Westchester and Nassau rank first and third among the sixty-two counties of New York State, and Fairfield is first among the eight counties of Connecticut. Major reasons for these favorable rankings are generally higher wage rates and greater property and proprietary income.

In keeping with the national historic trends toward diminishing regional differences, the region's lead over the national average is expected to drop slowly over the next half century.

As shown in Table 1.2-3 in constant (non-inflated) 1967 dollars, mean per capita income in the region was about $2,500 in 1950 and $4,200 in 1970. This is expected to increase to $6,900 by 1990 and $14,700 by 2020–a three-and-a-half fold rise between 1970 and 2020. Combining this increase in per capita income with the projected 73 percent increase in population produces a six-fold increase in total personal income–from $22.4 billion in 1970 to $136 billion in 2020.

TABLE 1.2-2 Population and Annual Growth Rates in the Seven-County Area (in Millions of Inhabitants)

	HISTORICAL[a]							PROJECTED[b]			
	1940	%	1950	%	1960	%	1970	%	1990	%	2020
Seven-county area:											
New London	.13	1.5	.15	2.5	.19	2.2	.23	1.1	.29	0.7	.35
Middlesex	.06	1.9	.07	2.8	.09	2.6	.12	1.8	.17	1.0	.22
New Haven	.48	1.2	.55	1.2	.66	1.2	.75	1.1	.93	0.6	1.11
Fairfield	.42	1.9	.51	2.6	.65	2.0	.79	1.3	.99	0.7	1.20
Westchester	.57	0.9	.63	2.6	.81	1.0	.90	0.8	1.06	0.4	1.19
Nassau	.41	5.1	.67	6.8	1.30	1.0	1.43	0.8	1.68	0.2	1.79
Suffolk	.20	3.4	.28	9.2	.67	5.2	1.13	3.3	2.15	1.5	3.38
Total	2.26	2.3	2.85	4.4	4.37	2.0	5.34	1.5	7.26	0.8	9.25
Some comparisons with other regions:											
7-county area	2.26	2.3	2.85	4.4	4.37	2.0	5.34	1.5	7.26	0.8	9.25
N.Y. City	7.45	0.6	7.91	-0.3	7.74	0.2	7.90	0.2	8.27	0.2	8.71
State of Conn.	1.71	1.6	2.00	2.4	2.54	1.8	3.03	1.0	3.71	0.8	4.65
State of N.Y.	13.48	1.0	14.83	1.3	16.78	0.8	18.24	0.7	20.95	0.6	25.22
United States	132.16	1.4	151.33	1.7	179.32	1.3	203.21	1.1	250.42	0.7	306.36

a. U.S. Census.
b. OBERS Series E projections. For more information see special LISS report, *An Economic Perspective,* July 1974.

TABLE 1.2-3 Per Capita Income in the Seven-County Area (in Thousands of 1967 Dollars)

	HISTORICAL[a]				PROJECTED[b]		
	1950	1959	1970	Annual % Change 1959-1970	1990	2020	Annual % Change 1970-2020
7 county area:							
New London	2.3	2.8	3.5	2.1	5.7	12.7	2.6
Middlesex	2.3	2.7	4.0	2.8	6.9	14.9	2.7
New Haven	2.5	2.9	4.0	2.4	6.7	14.3	2.6
Fairfield	2.5	3.0	4.3	2.8	7.3	15.7	2.6
Westchester	2.6	3.4	5.0	3.3	9.3	19.5	2.8
Nassau	2.7	3.2	4.6	2.7	8.1	17.5	2.7
Suffolk	2.2	2.5	3.2	1.9	5.2	11.6	2.6
Total	2.5	3.0	4.2	2.6	6.9	14.7	2.5
Some comparisons with other regions:							
7 county area	2.5	3.0	4.2	2.6	6.9	14.7	2.5
New York City	3.0	3.4	5.0	2.6	8.8	18.9	2.7
State of Connecticut	2.6	3.1	4.3	2.6	7.0	14.4	2.7
State of New York	2.6	3.0	4.2	2.4	7.3	14.8	2.6
United States	2.1	2.5	3.6	2.7	6.2	14.3	2.8

a. U.S. Census.
b. OBERS Series E projections. For more information see special LISS report, *An Economic Perspective,* July 1974.

TABLE 1.2-4 Earnings by Industry in the Four Connecticut Counties[a] (in Millions of 1967 Dollars)

SIC	Industry Group	HISTORICAL[b] 1959	1970	Annual % Change 1959-1970	PROJECTED[c] 1990	2020	Annual % Change 1970-2020
01-14	Agriculture, forestry, fisheries & mining	24	29	1.7	52	77	1.1
15-17	Contract construction	236	392	4.7	771	1,783	3.1
19-39	Manufacturing	1,641	2,276	3.0	4.088	8,581	2.7
40-49	Transportation & utilities	210	325	4.1	712	1,872	3.6
50-59	Wholesale & retail trade	557	878	4.2	1,608	3,605	3.0
60-67	Financial, insurance & real estate	143	222	4.1	567	1,514	3.9
70-89	Services	506	1,024	6.6	2,893	9,141	4.5
	Government	350	717	6.7	1,679	4,912	3.9
	TOTAL	3,681	5,879	4.3	12,370	31,485	3.6

a. Counted by place of work, not by place of residence.
b. U.S. Census.
c. OBERS Series E projections. For more information see special LISS report, *An Economic Perspective,* July 1974.

This six-fold increase is expected to place great pressure on the region's resources. With basic necessities such as food, clothing, and shelter commanding relatively fixed amounts of income each year, most of the projected increase will go to certain luxury items such as vacation homes, automobiles, air conditioners, recreation related items, and household furnishings. All but the last are closely related to the region's water and related land resources. As spending habits change with this real increase in purchasing power and as the median age of the region's population rises, households will also spend more on selected services such as medical care, personal care, education, and leisure activities.

Employment opportunities in the region should increase during the 1970s at a rate slower than for the nation as a whole. Total employment is projected to increase 65 percent between 1970 and 2000. Increases in future decades will be at a lesser rate than the present decade, reflecting in part a general equilibrium in female labor force participation rates at a significantly higher level than that of the 1960s. With a low birth rate, a larger proportion of the total population will be of working age relative to that which existed in years past. For example, the working aged population is expected to increase from about 62-63 percent of the total population for 1960 and 1970, to more than 68 percent by the year 2000, and about 70 percent by 2010, before dropping slightly as more people retire.

Total employment is projected to grow at about 1 percent annually from 1970 to 2020 for the overall region. The Connecticut segment should grow about 40 percent faster than the New York portion of the region. Suffolk and Middlesex Counties are the areas most likely to have the largest increase in employment, unless trends change drastically, with a 160 percent and 83 percent increase respectively between 1970 and 2000.

The region's economy is highly diversified, providing a certain degree of resiliency to economic conditions or environmental control programs that may be industry specific. Currently, earnings in the four Connecticut counties are derived 39 percent from manufacturing, 17 percent from services, 15 percent from the trades, 12 percent from government and 17 percent from everything else. In the three New York counties, manufacturing is less dominant, and the current mix is 23 percent services, 23 percent manufacturing, 18 percent trades, 17 percent government and 19 percent everything else. The major manufacturing sectors are electrical and non-electrical machinery, which are strong everywhere, and transportation equipment, which is strong in Nassau, Fairfield and New London. Professional services and business-and-repair services dominate the services industry. It will outdistance manufacturing before 2020 in Connecticut and will more than double manufacturing in the New York counties by then.

In the long term future, the industrial mix tends to emphasize the kinds of establishments that employ white collar workers, including many in the upper middle and higher income classes. Demands upon the Sound for recreational purposes, including power boating, can be anticipated to rise in reasonable proportion to the growth of these well paying industries.

TABLE 1.2-5 Earnings by Industry in the Three New York Counties[a] (in Millions of 1967 Dollars)

SIC	Industry Group	HISTORICAL[b] 1959	1970	Annual % Change 1959-1970	PROJECTED[c] 1990	2020	Annual % Change 1970-2020
01-14	Agriculture, forestry, fisheries & mining	22	26	1.4	91	135	1.6
15-17	Contract construction	436	670	4.0	1,235	2,573	2.7
19-39	Manufacturing	1,481	2,180	3.6	3,563	6,796	2.3
40-49	Transportation & utilities	291	535	5.7	938	1,965	2.6
50-59	Wholesale & retail trade	934	1,725	5.7	2,759	5,273	2.3
60-67	Financial, insurance & real estate	299	479	4.4	969	2,170	3.1
70-89	Services	1,264	2,242	5.4	5,696	15,372	3.9
	Government	833	1,561	5.9	3,444	8,848	3.6
	TOTAL	5,588	9,454	4.9	18,695	43,132	3.1

a. Counted by place of work, not by place of residence.

b. U.S. Census.

c. OBERS Series E projections. For more information see special LISS report, *An Economic Perspective*, July 1974.

Land use patterns. About 71 percent of the study region as a whole is open space, 55 percent in forests and undeveloped uplands and 16 percent in agricultural lands, wetlands, inland waters and recreational areas in that order. The remaining 29 percent is developed: 23 percent in residential use and 6 percent in public institutions, commercial, transporation, industrial, extractive, and utilities uses in that order.

These overall percentages, however, can be very misleading without recognizing very large differences between the subregions caused overwhelmingly by proximity to New York City. Table 1.2-6 brings out these differences. Notice, for example, how the percentage of open space drops steadily as New York City is approached in Subregion 6. Fully half of the land in that subregion is currently (1970) allocated to housing.

Also notice how relatively small in total acreage are three of the four New York subregions. This causes the land use data for the study region as a whole to be dominated by the Connecticut subregions. If, for example, the study region's Connecticut boundary had hugged the coast in a way generally similar to the Long Island boundary, the percentage of developed land in the Connecticut subregions would have risen greatly.

Although the choice of study boundaries thus affects the land use totals shown in Table 1.2-6, these boundaries presented no great difficulties. As explained in several places in this report, whenever an important consideration extended across the boundary, the study extended its scope for that particular purpose.

Regardless of boundaries, the overall land use pattern is clear. A very dense, highly developed pattern in the west drops off appreciably as the distance from New York City increases to the east, with major concentrations within two to five miles of the coast. On the mainland, open space becomes abundant as one moves inland. Not so on Long Island; if anything, developmental density there increases away from the coast.

Government. In Connecticut, the two principal levels of government are the state and town. At the state level, the agencies most involved with this study and its implementation are the Department of Environmental Protection (DEP) and the Planning and Budgeting Division (PBD) of the Department of Finance and Control. The DEP had representatives on every committee and work group except the Citizen Advisory Committee (CAC) and the Research/Planning Advisory Committee (R/PAC).

There is no county-level government in Connecticut. The Regional Planning Agencies (RPAs) have responsibility for comprehensive planning and coordination, but their conclusions are advisory, not binding on the towns. In accordance with over 300 years of state tradition, town government in Connecticut is exceptionally strong. Zoning controls, concentrated at this level, differ significantly in scope, policy, and implementation from town to town, with major authority usually focused in the town's zoning board of appeals. With the exception of major cities, the towns usually have little or no long-range planning staffs.

In New York, authority is more equally diffused between the three major levels of government, with the county level being particularly strong. The Department of Environmental Conservation represented the state on every committee and

TABLE 1.2-6 Land Use Patterns (in Percent)[a]

Land Use Category	SUBREGIONS 1	2	3	4	5	6	7	8	9	Total LIS Region
Open Space:										
Forest	59	68	42	40	33	9	11	25	6	43.0
Undeveloped upland	13	6	13	10	10	8	17	20	42	11.7
Agricultural	10	3	9	5	1	2	3	23	2	6.4
Wetlands	4	7	5	2	2	1	2	4	0	3.5
Water	3	4	2	3	2	7	5	2	1	3.4
Recreational	1	1	2	2	3	10	8	9	5	2.8
Subtotal	90	89	73	62	51	37	46	83	56	70.8
Developed:										
Residential	7	9	20	30	43	50	45	15	17	23.3
Public-institutional	1	0	1	2	2	5	4	1	21	1.6
Commercial	1	1	2	2	2	4	1	0	0	1.6
Transportation	1	1	2	1	1	2	2	0	6	1.3
Industrial	0	0	1	2	1	2	1	0	0	1.0
Extractive	0	0	1	0	0	0	1	1	0	.4
Utilities	0	0	0	0	0	0	0	0	0	.2
Subtotal	10	11	27	38	49	63	54	17	44	29.4
Thousands of acres:										
Open space	335	106	173	81	68	44	37	7	2	854.4
Developed	37	13	67	48	66	74	46	2	2	354.3
Total	372	119	240	129	134	118	83	9	4	1,208.7

a. Ralph M. Field and Associates.

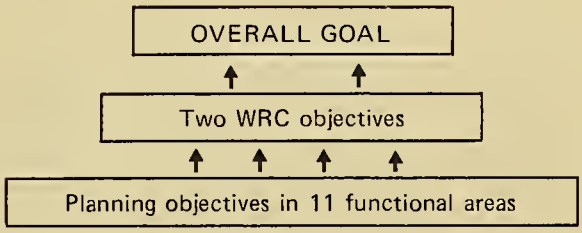
work group committee except the CAC and R/PAC and is expected to spearhead the implementation of the state-level recommendations of this study. The three counties of Westchester, Nassau, and Suffolk have strong planning staffs. In the small Bronx-Queens portions of the study region, planning is generally centralized at the New York City Planning Commission. On Long Island, the Nassau-Suffolk Regional Planning Board, which also participated extensively in this study, is particularly active. The Board has developed a Comprehensive Plan in brochure form.

The Board's actions are advisory, not mandatory for the two counties and the townships. Nevertheless, backed by strong press support, the Board's Comprehensive Plan has been ratified by Suffolk County and several of its ten towns. Although not formally ratified by Nassau County, the Comprehensive Plan informally guides many of the day-to-day decisions of that county and its townships. An element of the board, the Regional Marine Resources Council, has met bimonthly for eight years, has produced about thirty excellent reports and has recommended major policy and planning guidelines in the fields of integrated water supply and wastewater management, coast stabilization and protection, dredging, and wetlands preservation. Two towns and one city in Nassau County and five towns in Suffolk County border the Sound. Each contains a number of small villages. Zoning authority is delegated to the city, towns, and the incorporated villages.

At the federal level, many agencies have important responsibilities with respect to this study and its implementation. Since the federal government is generally organized on a functional basis, it was natural to have the various federal agencies play the lead role in developing the functional parts of the study.

Goals and Objectives

The overall goal of the study, to produce a plan of action balancing the need to protect, conserve, and wisely develop the Sound and its related shorelands, can be attained through the two broad study objectives established by the U.S. Water Resources Council and a set of individual objectives designed to meet needs identified in the eleven functional areas into which the study is divided.



The two broad objectives of the Water Resources Council are:

(1) **Environmental quality**, which seeks to enhance the quality of the environment through the management, conservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems, and

(2) **Economic development**, which seeks to increase the value of goods and services and to improve economic efficiency.

Key Planning Objectives

One or more planning objectives governs each of the study's eleven functional areas. They spell out succinctly what the study's recommendations are seeking to accomplish and, although the thrust in each case is to satisfy major recognized needs, it is important to realize that few of these objectives can be fully met. Full satisfaction is usually not worth the environmental, economic or social costs. The different elements into which the study is divided and their key planning objectives, to be achieved in environmentally, economically, and socially acceptable ways, are:

Water Quality. To achieve and maintain swimmable-fishable waters regionally before and through 1990 and to protect existing high quality waters from degradation.

Water Supply. To satisfy needs for potable water.

Land Use. To protect the available supply of special opportunity areas, particularly the shoreline, and to increase access to the amenities of the study area, particularly to the Sound itself.

Recreation. To improve the quality and quantity, distribution, and diversity of recreation opportunities for all people on or near the Sound.

Fish and Wildlife. To increase and maintain the biological productivity of the Sound's ecosystem, the economic value and enjoyment of its marine resources, and the productivity and enjoyment of its shoreland and upland wildlife resources.

Shoreline Appearance and Design. To identify, restore, preserve and enhance the Sound's major scenic and cultural resources.

Marine Transporation. To satisfy the needs and improve the system for the movement of cargo, especially petroleum, and people over the Sound.

Power. To satisfy the needs for electric power in the region and adjacent areas in a safe, reliable manner.

Minerals. To satisfy the region's needs for sand, gravel, and stone.

Flood Damage Reduction. To minimize coastal and riverine flood damages.

Erosion and Sedimentation. To minimize coastal and upland erosion and sedimentation losses.

Approach to Achieving the Goal

This chapter summarizes study methodology from the Plan of Study and how it was adjusted and amplified during the course of the study. The study's organization and management are explained along with some central concepts and the philosophy behind the interim reports, the planning reports, the special reports, and the plan formulation process. The several stages of the review process by the public and government are explained, along with the implementation process.

Plan of Study

The Plan of Study was prepared by a task force of federal, state, and regional officials under guidance of an Interim Coordinating Group established by NERBC. It was issued on August 1, 1971, one month after the study formally began. Although modified, as expected, several times during the study, it has been generally followed. It established the background, goal, and scope of the study—all described earlier in Section 1.1. To achieve the study goal, it called for a 3½-year, 3½-million dollar study[1]. It set up the organization, planning process, and public information and participation program described in modified form throughout the remainder of this chapter.

Study Organization and Management

The Long Island Sound Regional Study includes participants from the following agencies and organizations:

Federal-state:
- New England River Basins Commission (NERBC)

Federal:
- Department of Agriculture
  - Economic Research Service (ERS)
  - Forest Service (FS)
  - Soil Conservation Service (SCS)
- Department of the Army
  - Corps of Engineers (CE)
- Atomic Energy Commission (AEC)
- Department of Commerce
  - Bureau of Economic Analysis (BEA)
  - Maritime Administration (MARAD)
  - National Oceanic & Atmospheric Administration (NOAA)
- Environmental Protection Agency (EPA)
- Federal Power Commission (FPC)
- Department of Housing and Urban Development (HUD)
- Department of the Interior
  - Bureau of Mines (BOM)
  - Bureau of Outdoor Recreation (BOR)
  - Fish and Wildlife Service (FWS)
  - National Park Service (NPS)
  - U.S. Geological Survey (USGS)
- Department of Transportation (DOT)
  - U.S. Coast Guard (USCG)

State and sub-state regional:
- Connecticut
  - State Department of Environmental Protection (DEP)
  - State Planning and Budgeting Division (PBD)
- New York
  - State Department of Environmental Conservation (DEC)
  - State Office of Planning Services (OPS)
  - Nassau-Suffolk Regional Planning Board (NSRPB)

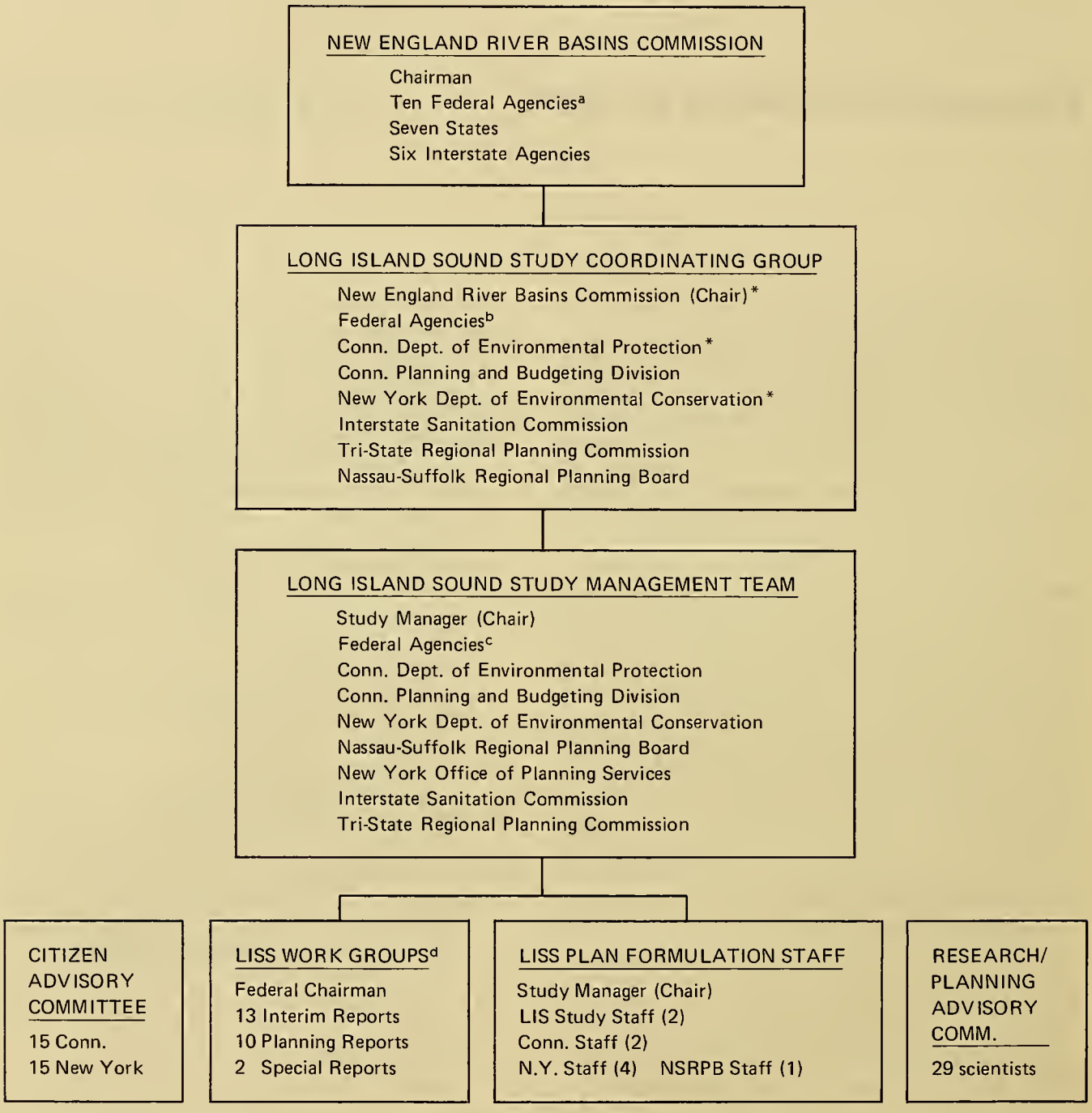
Interstate:
- Interstate Sanitation Commission (ISC)
- Tri-State Regional Planning Commission (TSRPC)

Advisory Groups:
- Citizen Advisory Committee (CAC)
- Research/Planning Advisory Committee (R/PAC)

These participants were organized into a study team as

[1] Both achieved despite a 1½ year gap in funding and major inflationary pressures on the study budget.

TABLE 1.4-1 Organization Chart, The Long Island Sound Regional Study



a. Agriculture, Army, AEC, Commerce, EPA, FPC, HEW, HUD, Interior & Transportation.
b. Same as Note (a), less HEW.
c. Same as Note (a), less AEC and HEW.
d. The LISS work groups with their chair and member agencies are listed in Table 1.4-2.

*NERBC, Conn. DEP, and N.Y. DEC constituted a Steering Committee which met between meetings of the Coordinating Group.

outlined in Table 1.4-1.

The *NERBC* functions with regard to the study were: (1) to develop overall general policy and objectives for the study, paying particular attention to issues of region-wide significance, institutional and legal issues, and issues affecting the entire commission membership, (2) to review and adopt the final plan for the Sound resulting from the study and to transmit the plan to the Governors of Connecticut and New York and to the President and the Congress, (3) to request adequate funding and manpower for agencies and committees participating in the study, and (4) to resolve problems which could not be handled at lower levels of organization.

The functions of the *Coordinating Group*, which met about four times a year, were: (1) to interpret and apply policy to substantive questions which arose in the course of the study, subject to later concurrence of the commission; (2) to review and transmit to the commission all reports and the comprehensive plan before publication, (3) to assure that agency personnel were assigned to the study team and that they contributed work in an agreed-upon and timely manner; (4) to coordinate budgets and to recommend to the commission required amounts of funds; (5) to coordinate the work of team members with the work of other personnel in their organization at both the headquarters and staff levels; (6) to advise the study manager from time to time; and (7) to resolve problems which could not be handled at lower levels of organization.

The *Steering Committee* was a small group of members of the Coordinating Group familiar with state goals. Between meetings of the Coordinating Group, it was empowered to act for that group and to advise the study manager on day-to-day problems, subject to later ratification by the group. In keeping with its intended responsiveness, the Steering Committee conducted much of its business by phone and memorandum.

The *Study Management Team* consisted of the study manager (chairman), his professional staff, and one or more members of the organizations listed previously. In contrast to members of the Coordinating Group, who represented the policy level in their respective organizations and whose attention was split between many responsibilities of which the study was only one—the members of the Study Management Team were generally the middle managers, work group chairmen and professionals charged with the actual drafting of parts of the study. Completing their assigned study reports was usually their major agency responsibility. They convened as a group about once a quarter to facilitate common understanding of the planning and report preparation processes and to improve coordination between work-groups.

The *Work (Planning) Groups* consisted of a chairman and about five to ten members from organizations especially related to the work group's subject area. The mission of each work group was to prepare an assigned report. The chairman of each work group worked very closely with the study manager and his staff. All work groups, together with their membership and assigned reports, are listed in Table 1.4-2.

The *Plan Formulation Staff* mirrored the Steering Committee but at the operating level. It helped the study manager coordinate the work groups and integrate their outputs into a single coordinated, comprehensive plan. It worked out of the office of the study manager and the state members gave upwards of a quarter of their time to this endeavour for part of the study.

The *Citizen Advisory Committee* consisted of thirty-two dedicated, informed, and unpaid citizens from the two states. Members were appointed by the Governors or by the Chairman, NERBC. The functions of the CAC were (1) to advise on the detailing and carrying out of the study, especially by evaluation of key study elements while participating in selected work groups where the reports were outlined and written; (2) to facilitate the widest possible public awareness of and contribution to the study, through contacts and communications with individuals and groups in public and private meetings; (3) to advise on significant or major development proposals coming up for decision before the study was completed; and (4) to assist in formulating, adopting, and implementing the plan. The CAC met about quarterly as a group and some of its members participated in selected work groups and chaired the many public workshops and meetings held around the Sound during the course of the study. Particularly useful was a set of goals drafted by the CAC during a formative stage of the planning process.

The *Research/Planning Advisory Committee* consisted of twenty-nine interested and highly knowledgeable scientists from education and research institutions with Long Island Sound interests. Members were appointed by the Chairman, NERBC. The objectives of R/PAC were (1) to integrate into the planning process scientific information and technological data that previous research had developed; (2) to insure that the research community was fully informed of the needs for new knowledge that arose during the planning process; and (3) to encourage the research community to respond to the major problems identified during the course of the study. The R/PAC met about quarterly, sometimes with the CAC. Many of its members made careful reviews of work group drafts. Particularly useful were a timely set of position papers drafted by R/PAC subcommitties making planning recommendations in most of the subject areas addressed by the study.

Coordination of the activity of the above agencies, groups, and committees was one of the principal jobs of the *Study Manager*. To assist him, he had a small staff consisting of two professional planners, a public information specialist and several assistants and secretaries. This staff also wrote several of the reports (as models), the brochure and most of the main report, as well as maintaining a voluminous correspondence with the public averaging several dozen mailings a day.

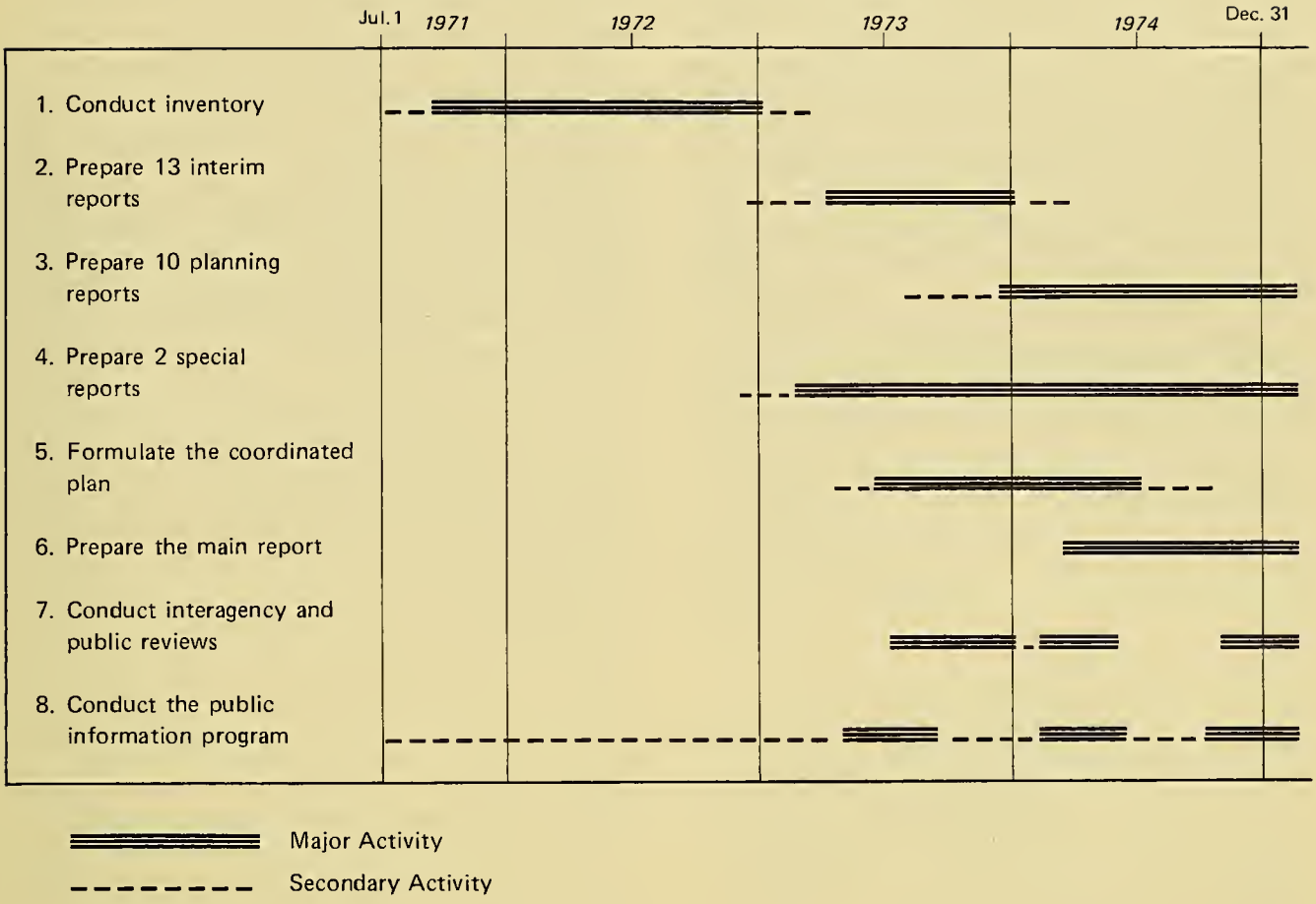
FIGURE 1.4-2 Assigned Reports, Work Groups, and Members

Assigned Reports	Agriculture			Army	AEC	Commerce			EPA	FPC	HUD	Interior					DOT	Connecticut		New York		NSRPB	ISC	TSRPC	CAC	R/PAC	LISS
Work-groups	ERS	FS	SCS	CE		BEA	MARAD	NOAA				BOM	BOR	FWS	NPS	USGS	USCG	DEP	PBD	DEC	OPS						Staff
Interim Reports:																											
Sources & Movements of Water			X	X				O								O	X	X		X					X	X	
Soils			O															X		X					X	X	
Water Quality				X					O	X						X	X	X		X					X	X	
Flood Plains			X	O							X							X		X					X	X	
Erosion & Sedimentation		X	O	O												X		X		X					X	X	
Water Supply				X					O							X		X		X		X			X	X	
Land Use & Ownership		X	X								O		X		X			X		X		X		X	X	X	
Ecological Studies								O						O				X		X					X	X	
Mineral Resources & Mining				X								O						X		X		X			X	X	
Electric Power Generation									X	O								X		X		X		X	X	X	
Marine Transportation				O			X										X	X		X				X	X		
Recreation				X									O				X	X		X		X		X		X	
Scenic & Cultural Resources															O			X		X		X			X		
Planning Reports:																											
Water Quality & Water Supply			X	X					O							X	X	X		X		X	X		X	X	
Erosion & Sedimentation		X	O	O												X		X		X					X	X	
Flood Damage Reduction			X	O							X							X		X					X	X	
Land Use		X	X								O		X		X			X	X	X	X	X		X	X	X	
Fish & Wildlife								O						O				X		X					X	X	
Minerals				X								O						X		X		X			X	X	
Power & the Environment									X	O								X		X		X		X	X	X	
Marine Transportation				O			X										X	X		X				X	X		
Recreation				X									O				X	X		X	X	X		X		X	
Shoreline Appearance & Design															O			X		X	X	X			X		
Special Reports:																											
An Economic Perspective	O	X				O												X		X		X		X	X	X	O
Legal & Institutional																		X		X					X	X	O

O = Chairman or Co-chairman

X = Member

FIGURE 1.4-1 Long Island Sound Study Schedule



Basic Concepts

Schedule. Figure 1.4-1 summarizes the actual progress of the study. The peak period of activity was the latter two-thirds of 1973 and the first half of 1974. Before that period, progress was slowed by funding delays. After that period, primary attention had to be given to editing, refinements, and publication.

Benchmark years. The years 1970, 1990, and 2020 were established as benchmark years. Insofar as feasible, the current situation was described in terms of 1970 data. Later information was available for many purposes, of course, and if particularly relevant it was used. To ease coordination between study elements, however, 1970 was the preferred year for basic data reporting purposes. With a few indicated exceptions, economic data were reported in terms of 1970 dollars. This frequently required updating ot extrapolating data through the use of the Consumer Price Index, the General Construction Index, and other expressions of major trends.

For mid-range planning purposes, 1990 was set as the principal benchmark. Most of the planning is geared to meeting conditions anticipated then. The major purpose of the year 2020 benchmark was to force the study to formulate its recommendations mindful of trends expected to persist beyond 1990. Anticipating year 2020 conditions is, of course, open to major error, particularly in forseeing public values. However, the requirement to think in terms of the future tended to illuminate the eventual consequences of maintaining current practices.

Subregions. To facilitate reporting and coordination between study elements, the study region was subdivided into the nine subregions shown earlier in Section 1.2. As stated then, study participants addressed the demand placed upon the resources within these subregions. They moved freely outside subregion boundaries to consider demand originating elsewhere for the resources of the Long Island Sound Region. They also recognized the likelihood of the "supply" situation elsewhere either exacerbating or alleviating pressure upon the Sound's resources, such as its beaches. A good example is the attraction exerted by Long Island's excellent Atlantic coast barrier beaches.

Population. In order to plan for the future of Long Island Sound, it is necessary to know about how many people can be expected to live in this region and put pressure upon the resource base. The OBERS Series E projections were selected for use as the baseline projections for this study because of their consistency with national

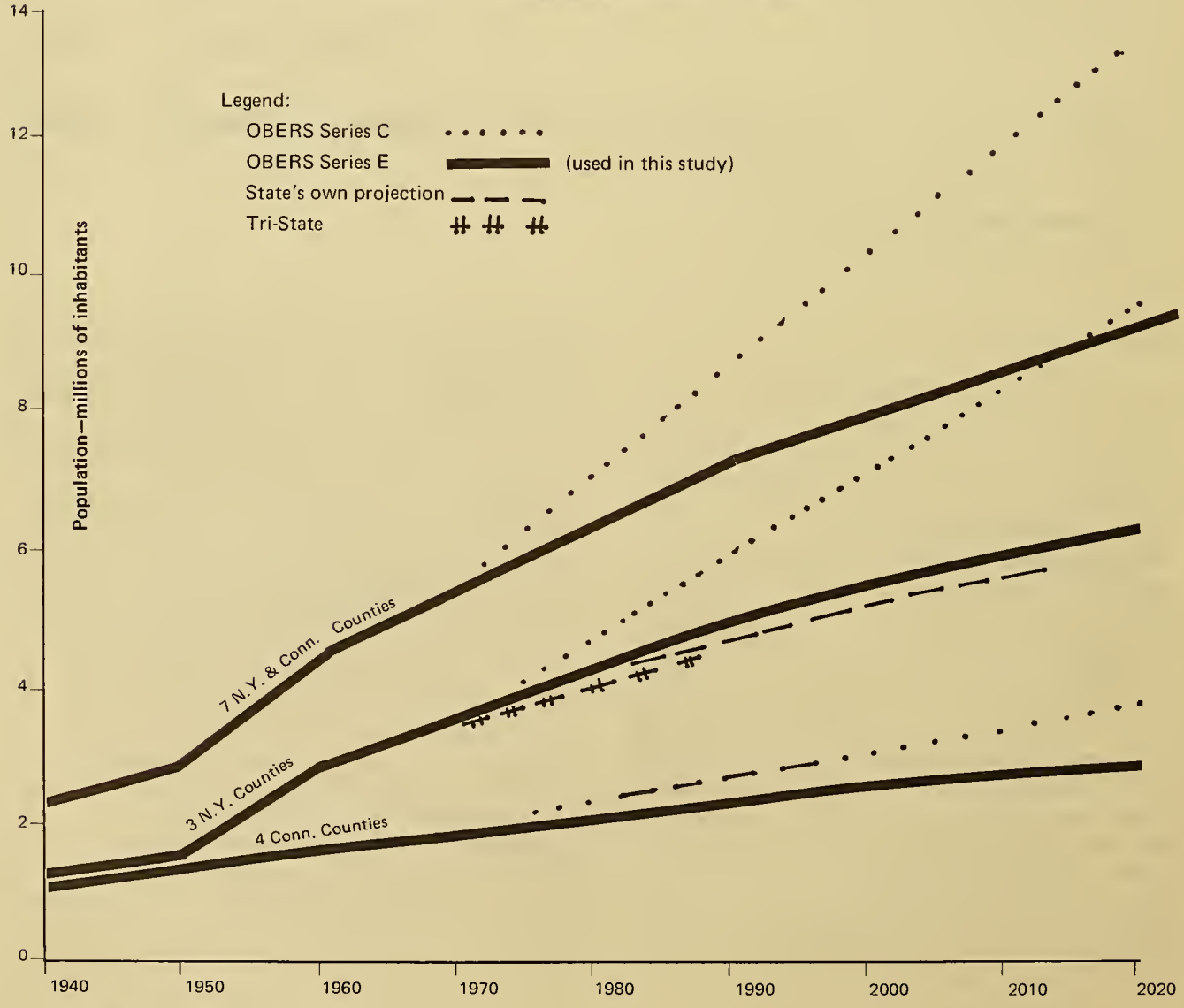
population and economic projections and because they provide a consistent set of projections for both benchmark years for the entire Long Island Sound Region, not just for a single state or group of counties. Many other less comprehensive projections exist. They are based primarily upon economic projections, demographic factors, and/or land capacities under existing zoning. The projections are "policy neutral" and merely reflect the continuation of present observed trends.

Figure 1.4-2 shows four of these projections. The Series C projection is based upon much higher fertility rates than have been experienced in recent years. It appears to be far out of line, especially in New York State. The other three projections show very close agreement. Almost all of the difference is concentrated in the projections for Suffolk County. OBERS Series E projects 600,000 or 700,000 more people there by 2020 than do the projections of state and the Nassau-Suffolk Regional Planning Board.

Projections developed by the Connecticut Planning and Budgeting Division extend only to the year 2000. Up to that point, they are slightly higher than the OBERS Series C and nearly 500,000 persons higher than the OBERS Series E used in this study.

Since population growth was one of the major factors used in projecting future demand upon the region's resources, use of a different set of projections would necessarily change all of these demand projections. The change, however, would generally be too small to warrant the effort to adjust by users of this study. According to projections of the New York Office of Planning Services, for example, the populations anticipated under OBERS Series E for 1990 and 2020 will not materialize until 1992 and 2028. Few demographers would show concern over such a small difference. All of the planners in this study dealt with much greater magnitudes of uncertainty—in future affluence, technology, and public values—when they formulated their projections. If change one must, it would be simpler merely to change the target date of the

FIGURE 1.4-2 Alternative Population Projections



projection rather than to confuse implementation by costly minor manipulation of these estimates.

In brief, the study team urges users of this study to incorporate the numerous projections made throughout the study, without change, into the user's planning. Generally, enough data has been given in the background reports to permit easy adjustment for more substantial matters such as major boundary differences. An exception to this recommendation is found in Suffolk County. Local planners and policy makers there will probably want to look more deeply into population projection differences beyond the year 2000. The special LISS report, *An Economic Perspective*, provides ample details to make any adjustments considered worthwhile.

Interim Reports

A complete list of all thirteen[1] interim reports is provided in the appendix to this report. The reports define the problems on their respective subject areas and summarize the inventory data most pertinent to understanding these problems. The purpose of the reports on *Soils* and *Sources and Movements of Water* was to provide background information for use in the other reports. The other reports were organized generally as follows:

Demand. What the public wants, as the planners were able to perceive it. This was put first to force an early articulation of what the planners understood the public wanted of them. If the planners were wrong, they wanted an early public feedback to reguide them.

Requirements. What the demand means in terms of the Sound. This required professional effort to translate, for example, public demand for outdoor recreation into miles of public beach, boat ramps, and other facilities or conditions required in the future.

Supply. The existing capacity of the resources in the study region to meet the requirements. Inventory data were entered here. How many miles of public beach are there? How many boat ramps?

Needs. Deficiencies in meeting requirements, now or in the future; essentially, requirements less supply.

The interim reports were given wide release, 700 to 1000 copies of each, throughout the region to lay the basis for the planning reports to follow and to sharpen public understanding of basic problems before alternatives and recommended solutions were presented.

Planning Reports

A complete list of all ten planning reports is provided in the appendix to this report. The planning reports show tentative solutions to the problems defined in the interim reports. These solutions represent advice to the study management team on recommendations to be included in the final report of the study. Often, however, the team rejected or modified these recommendations before incorporating them in their final report. This final report contains the recommendations of the study. The first half of each planning report consists of the applicable interim report, usually modified somewhat to reflect a growing understanding of the problem. The second half of each planning report develops solutions. It is generally organized as follows:

Objective. What was desired. The objective was usually stated in terms of satisfying a defined need in a way that respects environmental, economic, and social constraints. A complete list of all major objectives was given in Section 1.3.

Alternatives. What ways the objective might be achieved. The intent here was to mention all measures, conventional and unconventional, for solving the problem. To ease the subsequent analysis, however, the more frivolous measures were culled out after mentioning them.

Evaluation. How each alternative rated in terms of about fifty listed environmental, economic, and social criteria. This was usually the most difficult part of each report. To illustrate, an environmental impact statement must evaluate only the environmental impacts of a contemplated course of action. The planning reports, on the other hand, had to evaluate economic and social impacts as well—and do it for all alternatives, not just one. In making the economic evaluations, future benefits were discounted at the annual rate of 6-7/8 percent. At this writing, it appears that the discount rate might be lowered a percentage point. The effect will be to improve the economic justification of projects and policies which bestow large future benefits. In a few special instances, previously marginal projects might be recalculated. In general, however, recalculation can be deferred until the necessary individual project studies are conducted.

Plan formulation. What mixes of alternative measures best satisfied (1) environmental criteria, (2) economic criteria, and (3) a composite of environmental, economic, and social criteria. The result was three alternative plans: an environmental quality plan; an economic development plan; and a composite plan. The three plans were then compared in terms of satisfying the objective. The objective was usually left partially unfulfilled because the violation of major environmental, economic, and social restraints made the objective "just not worth it." In these cases, the implications of not fully meeting the objective were also pointed out.

Tentative (or workgroup) recommendations. The workgroups' recommendations, usually reflecting a composite plan, tempered to reflect public reaction to the recommendations presented in the draft of the main

[1] Eleven of the reports were published as separate documents. Much material from two interim reports, on *Land Use and Ownership* and on *Marine Transportation*, was incorporated into the first half of the planning reports on these two subjects.

report. The following information is given for each recommendation: who should be responsible for implementation, by what target date, within what cost ceiling, and at what expected measurable benefits. These were the workgroups' preferred plans, which they recommended to the larger study team, which could accept, modify, or reject them. However, the workgroup recommendations were printed in the planning report at this point.

Final recommendations of the New England River Basins Commission resulted from a final public review and subsequent modification of the workgroup recommendations. In most cases they are identical. In a few cases—most notably, site specific recommendations—the final plan formulation process (see below) resulted in additions and/or deletions to the tentative recommendations. In the cases of additions, whatever documentation exists can be found only in the main report.

Special Reports

Two special reports were prepared for the study: (1) An *Economic Perspective,* containing the economic and demographic data summarized earlier in Chapter 3, and (2) *Shoreline Appearance and Design: A Planning Handbook.*

Other Reports

A list of the other reports prepared for and in conjunction with this study is presented in the Appendix.

Plan Formulation Process

The purpose of plan formulation was to produce a coherent multi-purpose comprehensive plan. As indicated earlier, much of the plan formulation work in this study, in contrast to most other studies of this type, was accomplished as an integral part of each planning report. To improve the chances of achieving a harmonious fit, each work group preparing a planning report was required to rate its recommended measures against its understanding of all the other work group objectives, and to send a copy, including the rating, to each of the other work group chairmen and the plan formulation staff for review and comment.

In addition to coordinating the interfaces between planning areas, the individual recommendations had to fit together and be adjusted as a whole. This was accomplished in three phases as follows:

First Cut Plan Formulation

- Obtained initial input on demand, requirements, supply needs, and possible solutions from each work group.
- Conducted a series of ten public workshops and administered an additional survey of selected major issues.
- Applied the above information and results to part of one subregion.

Second Cut Plan Formulation

- Organized a plan formulation staff.
- Prepared and disseminated written step-by-step guidelines to each work group.
- Developed plan coordination forms and a system of multi-colored maps and overlays.
- Conducted an initial round of meetings with each work group chairman and developed an initial folio of about 600 working forms and thirty maps.
- Conducted area workshops to expose the initial recommendations to local planners at meetings in New Haven, New York and Hauppauge, Long Island.
- Obtained written input from the Citizen Advisory Committee and Research/Planning Advisory Committee.
- Reviewed revised recommendations with the Study Management Team.
- Obtained refined input from the work group chairmen.
- Wrote up revised recommendations in a prospectus for CAC and R/PAC review.
- Prepared and distributed 28,000 copies of a twenty-page tabloid newspaper summarizing results to date, including a list of about 100 tentative recommendations, and containing a four-page questionnaire designed to indicate the degree of acceptance each recommendation could expect.
- Participated in a series of eleven public meetings around the Sound to explain the recommendations and answer qiestions.

Third Cut Plan Formulation

- Analyzed public and official response to the brochure, questionnaire, and meetings.
- Revised the recommendations and clarified priorities.
- Wrote and revised three evolving drafts of the final report, subsequent to study team distribution and comment, before receiving Coordinating Group approval for the distribution of a final draft.
- Prepared and distributed the draft final report and a second full-size newspaper containing the summary of the draft plan, to study team members, elected officials, interested groups, and the public.
- Participated in a series of eight public meetings around the Sound to gauge public reaction to the revised plan and recommendations, and administered

a third questionnaire aimed at assessing public awareness of, interest in, and support of the Study.
- Obtained written input from all participating agencies, numerous groups, and the public.
- Revised the report and recommendations on the basis of submitted comments, subject to negotiation with their authors.
- Submitted the report to the Coordinating Group and NERBC.

Public Information Program

The aim of the public information program was to inform as many people as possible about the Long Island Sound Regional Study and about the commission's activities. The program informed the general public through (1) the *Urban Sea*, a newspaper-style newsletter issued four times, the fourth issue containing the summary of the draft final report; (2) through the series of ten public workshops in the summer of 1973, eleven public meetings in the spring of 1974, and public hearings in January 1975; (3) through three questionnaires, the first seeking public attitudes, the second seeking public reaction to tentative recommendations, and the third seeking opinion on the study's public participation process; (4) through numerous press releases; (5) through speaking engagements and radio and TV interviews; (6) through wide early distribution of interim reports; (7) through the participation of the CAC and R/PAC; and (8) by responding to numerous letters and phone calls. In addition, the study's New Haven office, library, professional staff and files were available to the public during working hours.

Reviews

Because of the frequent meetings of the various study groups and committees, almost every major action in the study was under continual review. Formal interagency reviews by fifty to sixty people preceeded the publication of each of the thirteen interim reports, the ten planning reports, the two special reports and this final report. The public had an early opportunity to review tentative recommendations at the series of public meetings in March and April 1974 and a later opportunity to review draft final recommendations and supporting text during public hearings on the draft final report in January, 1975.

The Coordinating Group reviewed and approved the draft final report. The Governors and the heads of federal and interstate agencies then began a formal ninety-day review period in November, 1974.

Because the states were active members of all elements of the study team, the final review did not come as a surprise. The main purpose of the ninety-day review was to permit consideration of and comment on the plan in its comprehensive but non-final form.

After transmittal, this study will be reviewed by the U.S. Water Resources Council. To minimize any possible difficulties at that final stage, the study manager and NERBC have maintained close contact with the Council, sending it earlier drafts of this report, and have followed its guidelines on principles, standards, and procedures.

Implementation

Implementation of some recommendations has already begun, but most remain for after the study's completion. Section Four: Carrying Out the Plan contains a concise checklist for governors and heads of major federal and state agencies to follow to insure that the recommendations they have approved are actually carried to fruition.

2.1 Water Management
2.2 Land Use and Growth
2.3 Outdoor Recreation
2.4 Sport Fisheries and Wildlife
2.5 Shoreline Appearance and Design
2.6 Marine Transportation
2.7 Power and the Environment
2.8 Commercial Fishing
2.9 Mineral Resources and Mining
2.10 Flood Damage Reduction
2.11 Erosion and Sedimentation

2 The Plan by Major Subjects

Water Management

Water resource managers are increasingly aware that programs to deal with water pollution and plans for future water supply must be consistent with each other. It is also apparent that land use development has a significant impact on water quality, waste disposal, and water supply planning. A water management plan is essential to ensure the compatibility of these related growth impacts in the future development of the Long Island Sound region. The objective of the water management plan is to present programs which will satisfy the requirements for future water supply and which will preserve or restore water of desired quality in an economically, socially, and environmentally acceptable way.

Background on water quality situation

The waters of Long Island Sound, its embayments, and estuaries today vary greatly in quality. The western Sound, particularly the area near the Throg's Neck Bridge, is badly polluted. During the summer of 1974, shellfish beds were closed around almost the entire western end from Oyster Bay on Long Island to New Haven in Connecticut, due to actual or potential bacterial and viral contamination. At many locations, beach swimming is unpleasant during much of the summer because of the water pollution and presence of excessive algae and other marine plant life. Some beaches are even periodically unsafe for swimming and must be closed. The areas in the region with water quality problems are shown in Figure 2.1-1. From Hempstead Harbor eastward to the area near the mouth of the Connecticut River, water quality is fairly uniform and of intermediate quality. East of the Connecticut River, water quality is good.

Major sources of pollution affecting Long Island Sound include: inadequately treated municipal and industrial wastes, overflows from combined sewers, non-point sources, wastes from pleasure craft and other boats, oil and other hazardous materials spilled from ships and also from bulk storage areas, heated water inputs from power plants, and inflows from rivers. The relative significance of man-made sources of water pollution is complicated by the fact that contaminants often enter the water in complex mixtures of many substances whose specific chemical identities are largely unknown, and by the fact that the Sound has a complex water circulation pattern.

The worst contributors of pollution in the region are the municipal and industrial sources. Municipal sources are dominated, in terms of volume and costs of treatment, by the New York City discharges to the East River which flow back and forth past Throg's Neck into the western Sound. Table 2.1-1 shows the relative magnitude of the municipal waste discharges from various geographic regions for both present and scheduled treatment levels. Not enough information is available on the net transport through Throg's Neck to state with any real accuracy what proportion of the pollution load remains in the Sound as compared to the amount that flows back into the East River.

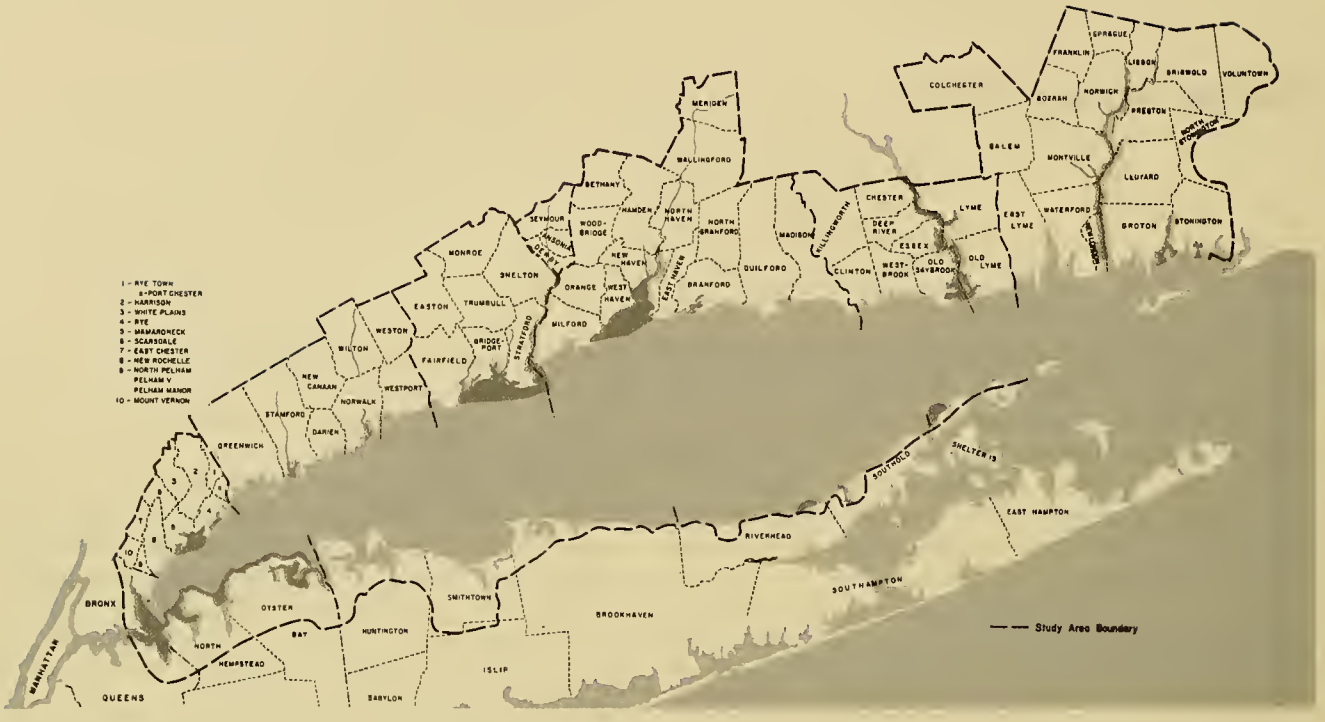
There are other sources of biochemical oxygen demand (BOD), including industrial wastes, combined and storm sewer overflows, and land runoff. Several other important indicators of pollution are coliform bacteria, dissolved oxygen, algal blooms, suspended solids, and heavy metals. Generally, however, the table does present a fairly good geographic perspective of the actual pollution sources.

It also shows that when the upgrading of all existing municipal and institutional treatment plants to secondary is completed (around 1980), the BOD load will be reduced by almost two-thirds. Higher levels of treatment at municipal treatment facilities will be required in areas where these reduced loads will still exceed the assimilative capacity of the receiving waters.

A total of fifty-five major industrial discharges are located in the study region, including twelve major electric power generating plants which heat their cooling water 13°–27°F above the intake temperature. Industrial wastes are expecially significant along many of the streams and harbors in Connecticut. These industries are required to obtain a permit which commits them to reduce or eliminate their harmful discharges in an orderly fashion in specified steps at specified times.

Harmful industrial wastes can include organic matter,

FIGURE 2.1-1 Existing Violations of Water Quality Standards



floating solids, heavy metals, other toxics such as cyanides, oil, and many other processing wastes.

Pollution abatement efforts up to this time have focussed almost entirely on eliminating the harmful effects of the two major sources: municipal and industrial wastes. As these cleanup programs near completion, the magnitude of the many other pollution sources, such as sediment, other non-point sources, and combined sewers, is now evident.

The most significant of these other sources are overflows from combined sanitary-storm sewer systems. During heavy rainfalls the collection and treatment capacities of these systems can be exceeded, resulting in discharge of untreated or inadequately treated wastewater. These overflows have caused the closure of beaches and shellfish harvesting areas, the lowering of water quality below state and federal standards, health hazards when sewers back up and flood streets, and unsightly conditions in rivers, harbors, and bays because of floating sewage and debris.

The fact that combined sewer overflows may occur only once a month gives a very misleading impression about their pollution load. Studies in Buffalo, New York, have shown that 20–30 percent of the domestic sewage solids collected annually are settled in the sewer system and eventually discharged during storms.[1] Consequently, a large residual sanitary pollution load, over and above that normally carried, is discharged in a very short period of time. These "shock loadings" are especially harmful to marine life.

Fourteen municipal collection systems, serving approximately 850,000 people within the study region, have combined sanitary-storm sewer systems. These municipal systems include Norwich, the Jewett City section of Griswold, Derby, Shelton, Seymour, New Haven, Bridgeport, and Norwalk in Connecticut; Port Chester, Blind Brook, Mamaroneck, New Rochelle, the Eastchester Bay area and City and Hart Islands in the Bronx, and Queens in New York.

Other pollution sources in the Sound include oil and other hazardous material spills, dredging and dredge spoil disposal, and watercraft wastes. Oil is discharged into the Sound in several ways. In the period 1971-72, 540,000 gallons[2] are known to have been spilled directly from vessels and storage tanks. Oil contamination from other sources is harder to measure, but probably exceeds the total amount from spills. Among the other major contributors of oil to the Sound are air-borne precipitates, overflows from combined sewers, urban runoff, seepage from oil terminals, oily bilge water, industrial cooling and process water, and discharge exhaust from two-cycle outboard engines used on recreational boats. Little is known about the possible environmental disruption from these chronic but low concentration sources. Further study of these chronic

[1] *Combined Sewer Overflow Seminar Papers,* EPA Technology Series, November, 1973.

[2] *Water Quality, An Interim Report,* Long Island Sound Regional Study, New England River Basins Commission, March, 1974.

TABLE 2.1-1 Municipal Wastes Discharged into Long Island Sound from Sources Located Within the Study Region

Location	Type of Treatment System	Population Served	Waterborne Discharges (MGD)	BOD Load[a] Prior to Treatment (Tons/Day)	Assumed Removal Efficiency	BOD Load Discharges into Study Region (Tons/Day)	BOD Load if All Plants Are Secondary–85% Removal (Tons/Day)
Connecticut	Primary	542,855	97.95	81.69	30%	62.90	12.25
	Secondary	459,645	84.41	70.40	85%	10.56	10.56
	Ground	481,000	0	0	0	0	0
	Subtotal	1,483,500	182.36	152.09		73.46	22.81
Westchester, Bronx, Queens, New York	Primary	183,500	35.70	29.77	30%	20.84	4.47
	Secondary	3,491,000[c]	575.00	480.00	70%	144.00	72.00
	Ground	Unknown[b]	0	0	0	0	0
	Subtotal	Unknown[b]	610.70	509.77		164.84	76.47
Nassau, Suffolk	Primary	12,250	1.53	1.28	30%	0.90	0.19
	Secondary	109,008	15.55	12.97	85%	1.95	1.95
	Ground	Unknown[b]	0	0	0	0	0
	Subtotal	Unknown[b]	17.08	14.25		2.85	2.14
Totals of Above	Primary	738,605	135.18	112.74	30%	84.64	16.91
	Secondary	4,059,653	674.96	563.37		156.51	84.51
	TOTAL	4,798,258	810.14	676.11		241.15	101.42

a. Assumed that strength of wastewater coming into municipal system exerts average BOD load of 200 mg/l.

b. Wastewater discharged to ground through cesspools and septic systems is rare in the Bronx and Queens, common in Nassau County, and almost universal in Suffolk. Exact quantities for the LIS portion of these counties is difficult to determine because the LIS region boundary does not follow township or census tract lines.

c. Four Municipal Treatment Plants which discharge into Upper East River.

sources is needed to determine whether their effects are serious. But since we are sure that oil pollution sources which create high localized concentrations, such as tanker spills, can be damaging, this plan gives special attention to these sources.

The possible threats to water quality and marine life from dredging and dredge spoil disposal have fostered bitter debate throughout the region over the last few years. As a result, the New Haven Harbor maintenance program (800,000 cu. yds.) and the Navy's proposed deepening of New London Harbor to thirty-six feet (2,800,000 cu. yds.) will be carefully monitored at both the disposal and dredging sites before, during, and after the operations. Also, the number of disposal sites in the Sound has been reduced from seventeen to four–at Eaton's Neck, New Haven, Cornfield Shoal, and New London–which will facilitate monitoring of dumping in the future.

All types of vessels contribute untreated or inadequately treated wastes to local harbors and in the open waters of the Sound. All commercial vessels and about 50,000 pleasure craft in the Sound are large enough to carry heads. Waste discharged from such boats can cause health and aesthetic problems, particularly in poorly flushed harbors. A number of shellfish beds in New York and Connecticut are closed because of potential fecal contamination resulting from their proximity to a marina.

The abatement of water pollution sources has traditionally been a multi-agency, multi-purpose effort involving private citizens and industries as well as local, state, interstate, and federal cooperation. Connecticut began its comprehensive approach towards the problems of water pollution control with the passage of the Connecticut Clean Water Act of 1967.

The basis of the New York State Water Pollution Control Program is Article 17 of the Environmental Conservation Law, which enumerates the Water Pollution Control Policy and the duties of the New York State Department of Environmental Conservation.

In addition, the Interstate Sanitation Commission is involved in planning water pollution control programs in

the tidal waters of the New York metropolitan area, extending as far east as New Haven and Port Jefferson.

The 1972 Federal Water Pollution Control Act Amendments create a water pollution control program based on three major elements: uniform nationwide standards, enforceable regulations, and a permit program based on effluent limits and geared to specific goals. The Connecticut, New York, and federal water pollution laws provide a framework in which all levels of government may act to abate water pollution.

Background on Water Supply Situation

The existing water supply situation in the Long Island Sound region is best summarized on a state basis because of the differing sources of supply. Connecticut relies primarily on surface water sources with some use of ground water. In the New York region, Westchester County and the Boroughs of Bronx and Queens rely on the New York City system, while Nassau and Suffolk Counties are supplied almost entirely by ground water sources.

Connecticut has water systems serving less than 100 people, as well as systems serving more than 300,000. Safe yields vary from 10,000 gallons of water per day to 89 million gallons per day (MGD), indicating the degree of system variability. In 1970, approximately 85 percent of the Connecticut population residing within the LISS region, or about 1.3 million people, obtained their water from public water supply systems. The average daily demand from public water supply systems generated by this population was nearly 212 million gallons per day. The developed sources of supply have a capacity of more than 278 MGD.

Many of the Connecticut water systems are under pressure to open their reservoirs and watershed lands to multi-purpose use. Connecticut's *Plan for Conservation and Development* presents a policy to protect water supply watersheds in general and water supply sources in particular. In 1973, the Connecticut General Assembly passed Public Act 555, which pertains to future development of water resources. The provisions of the act include prohibition of waste discharge into streams tributary to either existing water supply reservoirs or future water supply reservoirs proposed in the Water Resources Plan, which is currently being developed. In 1974, the Connecticut General Assembly passed Public Act 303, which specifies that the State Department of Health must approve the sale of water utility lands.

In the New York area, there are two distinctly different types of water systems. Westchester County and the Boroughs of Bronx and Queens are supplied for the most part by the New York City system of reservoirs, whereas Nassau and Suffolk Counties depend almost entirely on well water.

About 6.2 million people, or 96 percent of the total population in and around the LISS region (Westchester County, Bronx, Queens, and all of Nassau and Suffolk Counties), consumed about 927 MGD in 1970. Developed sources of supply, including the entire New York City system, have a capacity of 2,320 MGD. In 1970, 900 MGD was delivered to that part of New York City and upstate areas not included in the study area. In fact, the New York City system in that year delivered a total amount of water greater than its safe yield. See Table 2.1-2 for additional estimates of existing and future water demands by subregion.

Problems

The major water management problems in the LISS area are: (1) cumulative stress of pollution on Long Island Sound; (2) closed shellfish beds and recreational swimming areas; (3) decline in both quality and quantity of groundwater on Long Island; (4) water quality degradation due to present land use patterns; (5) lack of interconnections between small water supply systems; (6) inadequate funding for water quality management; and (7) near-field effects of thermal discharges on marine life. The latter problem, however, is discussed in Section 2.7 Power and the Environment.

The cumulative stress of pollution on the Sound is a serious problem on which much greater attention must be focussed. Long Island Sound has long been the repository for many pollutants. It is still not possible to make quantitative predictions of the cumulative effects of pollution, such as the nutrients and toxic substances which enter Long Island Sound. This is complicated particularly by our lack of understanding of the three dimensional circulation pattern in the Sound and its variations with time.

Some scientists have voiced serious concern over the eutrophication problem caused by man-added nutrients in parts of Long Island Sound. The short-term effects of excessive enrichment are generally rapid growth or blooms of algae, resulting in large daily fluctuations in oxygen concentrations, lowered dissolved oxygen due to algae die-off and biodegradation, and possible berthic animal and fish kills because of oxygen stress. An attendant problem is a general lowering of the aesthetic and recreational values of the water. Long term effects include an increased rate of aging of the body of water, characterized by increased plant production, shifts in species composition, and a net increase of plant and animal biomass due to increased flow of food through the food chain. Recent cruises have shown that persistent algal blooms of nuisance proportions have occurred in the western part of Long Island Sound, where nutrient input is greatest and circulation restricted. An unpublished staff report prepared by New York State Department of Environmental Conservation indicates:

> These effects are immediately attributed to nitrogen contributions to Long Island Sound from the New York City area . . . It can be assumed, however, unless denitrification occurs extensively in mud flats around the East River that all the nitrogen discharged into the East River (from municipal

TABLE 2.1-2 Existing and Future Water Demands in the Study Region

Subregion	1970 Pop. Served (1000)	1970 Avg. Day Demand (MGD)	1970 Safe Yield (MGD)	1990 Pop. Served (1000)	1990 Avg. Day Demand (MGD)	1990 Need[a] (MGD)	2020 Pop. Served (1000)	2020 Avg. Day Demand (MGD)	2020 Need[a] (MGD)
1	143.3	24.0	39.4	203.1	35.0	4.3	279.9	52.0	14.6
2	20.9	2.9	5.4	46.0	7.4	2.0	76.8	14.0	8.6
3	489.1	68.9	85.8	608.2	104.3	19.0	742.3	147.4	61.6
4 & 5	669.7	115.9	148.0	854.4	171.9	24.0	1,059.2	247.7	99.7
Conn. Subtotal	1,323.0	211.7	278.6	1,711.7	318.6	49.3	2,158.2	461.1	184.5
6a	373.4	53.1	1,329.0	383.9	55.5		436.2	64.3	
6b	3,458.8	494.7[b]		3,518.9	538.4		3,419.4	574.4	
Nassau County	1,436.8	214.1[c]	151.0	1,649.6	250.8	92.0	1,767.4	289.9	177.0
Suffolk County	1,164.5	165.2	440.0	1,978.3	282.7	0	2,813.2	402.4	0
N.Y. Subtotal	6,433.5	927.1	1,920.0	7,530.7	1,127.4		8,436.2	1,331.0	
Regional Total	7,756.5	1,138.8	2,198.6	9,242.4	1,466.0		10,594.4	1,792.1	

a. Water systems having estimated surpluses are not included in the calculation of these totals if these systems cannot presently provide water to systems expected to experience shortages.

b. The 1970 average daily demand on the entire New York City system was 1,334 MGD.

c. Much of Nassau County's present demand is nonconsumptive, with the wastewater being discharged back to the aquifer. However, future demands are not predictable since more of the wastewater may be carried away from the aquifers and discharged to the Sound or ocean.

treatment plants) eventually finds its way into either the Sound or New York Harbor . . .

Using the present flows to the New York City treatment plants, existing nitrogen data for other New York State discharges, population estimates for Connecticut and for other discharges to the Connecticut River Basin, and appropriate runoff co-efficients, the nitrogen loads to the Sound are estimated in the following table:

Sources of Nitrogen	Lbs. Nitrogen/Day	Percent
New York City	170,000	54.0
New York State	15,000	4.8
Runoff	50,000	15.8
Rainfall on Sound	5,000	1.6
Connecticut*	75,000	23.8
Total	315,000	100.0

*Including Massachusetts, Vermont, and New Hampshire discharges to the Connecticut River.

Because of this nitrogen input and localized poor flushing, the eutrophication problem is not limited to western Long Island Sound, but is also evident in many of the harbors and embayments, such as Branford Harbor in Connecticut and Hempstead Harbor and Oyster Bay in New York.

One way in which the eutrophication process might be slowed is by limiting the addition of nutrient materials. Treatment of waste discharges to decrease their nutrient content, however, is not well understood. Control of any single nutrient will be effective only if that nutrient can be reduced to a level low enough to be limiting to algal growth. As mentioned, it is believed that nitrogen is the controlling nutrient for western Long Island Sound. To add nitrogen removal to the municipal treatment plants in subregion 6 (including the four on the Upper East River) would cost $300 million. This does not include land costs. The inclusion of operation and maintenance costs and amortized construction costs would result in an annual bill for this additional treatment of $35 million. Even with nitrogen removal at municipal facilities, it cannot be assured that the algal blooms in western Long Island Sound would be eliminated.

The discharge of toxic substances also has cumulative damaging effects on the waters and sediments of the Sound and its embayments. These toxic substances include heavy metals such as lead, mercury, and cadmium, petroleum products, pesticides, cyanide, and PCBs (polychlorinated biphenyls). Often in the natural breakdown of some of these substances, other toxic compounds are formed.

The bottom of the Sound tends to act as a repository or sink for many toxics which emanate from municipal and industrial discharges, combined sewer overflows, urban and rural runoff, and oil spills. These wastes can persist in the sediments and benthic community for long periods of time, and generally reach higher concentrations in the tissues of each succeeding level of the food chain. Shellfish, because they are filter feeders, take in and absorb far more of these wastes per pound of weight than do any other organisms. This affects their health and productivity as well as that of their predators, people and birds included.

The potential damage from these toxics in the sediments is reduced by the constant sedimentation process which covers the old bottom. Only the top few inches of this sediment are used for feeding by benthic organisms, while bottom currents keep some sediment suspended and available to other feeders. Unfortunately for all of these trophic levels, dredging is frequently required to remove accumulation of silt and provide for safe and economical navigation. In many industrial harbors and disposal sites, dredging and spoils disposal damage marine life through increased turbidity, buildup of heavy metals, oxygen demanding material and sediment, and removal of substrate materials.

The most visible water quality problems within the study area are the *closed shellfish beds and recreational swimming areas*. There are over 100,000 acres within the study area closed to the harvesting of shellfish due to pollution. See Sections 2.4 Sport Fisheries and Wildlife, and 2.8 Commercial Fishing for additional discussion.

During the past ten years, there has been a tremendous increase in the amount of activity and money spent for water pollution abatement within the study area. Yet each year, rather than opening up new recreational and shellfishing areas, it appears that more areas are closed. For example, during the past summer all of western Long Island Sound was closed to shellfishing.

Why is this happening? One reason is that public health regulatory standards concerning the dangers of swimming in polluted waters and eating shellfish taken from polluted water are being more strictly enforced and implemented. Shellfish have long been implicated as significant vectors of typhoid fever and other enteric diseases. They are also a transmitting agent for infectious hepatitis. Interpretations of shellfish harvesting standards are becoming much more rigorous, because the shellfish strain bacterial and viral pathogens, radionuclides, heavy metals, pesticides, organics, metallic compounds, and parasitic protozoa and worms.

For these reasons, all shellfish growing waters of the state must be classified as to their sanitary suitability. To be fully approved for commercial and recreational shellfishing, the areas must meet two requirements: (1) based on the bacteriological quality of the water, the total coliform count does not exceed 70 per 100 ml; and (2) the area is sufficiently removed from wastewater outfalls and other pollution sources so that the shellfish would not be subjected to fecal contamination which might be dangerous to public health.

Because of increased concern for public health, the interpretation of these standards is becoming increasingly stringent. If population and economic development, with its associated urban and suburban sprawl, continues along the shoreline, more shellfish areas will be closed due to their proximity to new sources of pollution.

Existing data are inconclusive as to the direct public

health effects of swimming in polluted waters. Studies suggest that the coliform standards may have imposed an economic and social burden by denying the use of beaches to the public on the basis of an erroneous assumption. These closed areas, unfortunately, are generally close to urban centers, where they are most needed. Because these areas were considered unsafe for swimming, public access has not been protected. Research is urgently needed to determine whether the current standards for swimming are adequate or overly conservative in protecting public health.

Swimming is presently considered unsafe in all of the commercial harbors in Connecticut; in the Thames, Connecticut, Quinnipiac, lower Housatonic, and East (N.Y. City) Rivers; and in many smaller streams. Beaches are also closed in Little Neck Bay and Eastchester Bay in New York. Because of the Sound's large assimilative capacity, very few of its beaches are closed regularly. After heavy summer rainstorms, however, many of the beaches, particularly around the cities, have to be closed from one day up to a week. Combined sewer overflows and urban runoff are the principal causes of this pollution.

How best to manage the ground water resources of Long Island is another major problem. Street paving, building construction, discharges of fresh water to the sea as waste water effluent and storm sewer runoff to the ocean, and increased water withdrawals have reduced ground water recharge and lowered the water table in some parts of Long Island. In areas not completely sewered, cesspool effluents from dwellings have resulted in widespread contamination of the upper aquifer, abandonment of many of the shallow wells, and the installation of public supply wells tapping the deeper parts of the ground water reservoir. Large net withdrawals from the ground water in the past have caused salt water intrusion in certain coastal areas. Increased withdrawal rates may cause further dydrologic imbalance and serious salt water intrusion.

Experience under the exisiting water quality programs has shown that land use significantly affects the quality of water. Present land use patterns degrade water quality in three ways: by permitting damaging and perhaps poorly distributed point sources of pollution; by generating urban and rural runoff; and by destroying natural protective mechanisms, such as wetlands, flood plains, and vegetative cover, which may reduce the quantity of impact of pollutants washed from the land to open waters.

A major problem facing the Long Island Sound area is the conflict between increased development requirements, recreational demand and the preservation of the Sound's natural resources. In the absence of an enforceable land use policy, development will continue with minimal regard for the environment. The water cleanup program can be self-defeating if it merely stimulates unsound shoreland development that generates another round of pollution. Furthermore, land use controls are necessary to maintain wetland and greenspace systems.

Finally, complementary land management practices must control non-point pollution from urban and rural runoff. A key problem is how the federal, state, and local governments should use land policy as an environmental management technique, and conversely, how they should use the air, water, and other environmental legislation to help guide growth and land use patterns. For example, local communities could adopt land management zoning such as green belts and minimum lot sizes to reduce the impact on water quality.

The lack of interconnections between small water supply systems, particularly in Connecticut, causes a variety of inefficiencies and possible hazards. In case of severe drought, the probability of one of these small companies, public or private, experiencing a shortage is greater than for a large regional system. Water quality data demonstrates that in areas using surface water, the large suppliers generally are able to obtain better quality sources, or provide better treatment for poorer sources. The large suppliers generally also provide better staffing for their laboratories and sanitary surveys, and have better equipment to carry out analytical tests than do the smaller ones.

Inadequate water quality management funding may be the biggest water management problem in the study area. Impoundment of 50 percent of federal appropriations during the last three years has slowed the scheduled abatement programs considerably. The high costs of achieving the water quality goals called for in this report will require increased levels of funding during the next decade. Long Island Sound is bordered by two of the nation's most progressive states in the water pollution control field. Both have construction grant programs and strong regulatory controls over industries. Such programs insure that, by the end of this decade, all the minicipal treatment plants will be providing at least secondary treatment, and the most damaging sources of industrial pollution will be abated. Public costs to complete this portion of the water quality management program are approximately $280 million for Connecticut and $340 million for New York.

Current estimates for combined sewer corrections, utilizing a combination of storage, treatment, and separation in the Connecticut portion of the study area, are $200 million, while the Upper East River, Eastchester Bay area, and Westchester County combined sewer correction programs will cost upwards of $2 billion. Any attempt to provide extensive advanced treatment facilities in western Long Island Sound and recharge projects on Long Island will not only increase construction cost substantially, but will raise operation and maintenance costs.

Another unresolved problem involves the collection and treatment of stormwater runoff. In the New York portion of the region alone, it is estimated that the cost for full treatment would be $1.8 billion, with an additional $1.1 billion required for expansion of facilities by 1990.

Attaining Water Quality Goals in Urban Harbors, Rivers, and Embayments.

The on-going water quality management programs within the study area will insure that all municipal wastewater treatment facilities have secondary treatment and all industries have "best practicable treatment" by 1983. However, even with this level of pollution abatement, many of the urban streams and harbors may not achieve water quality goals. Significant water quality problem areas are the Thames River, Quinnipiac River, New Haven Harbor, Branford Harbor, the Housatonic Estuary, Bridgeport Harbor, Norwalk Harbor, and western Long Island Sound.

New London, Norwich, and Groton are large urban areas on the Thames River. Significant quantities of storm water from city streets, with varying degrees of polluting oil, organic matter, and bacteria, are discharged to the Thames River. Land management practices along this river may be necessary to prevent street and parking lot runoff from polluting the Thames. However, the major sources of pollution to the Thames River are believed to be the combined sewers of the city of Norwich and the primary effluents from Norwich and New London treatment plants, and from the Pfizer Chemical Company. Norwich is now beginning the process of separating its storm and sanitary sewers, and a study of alternatives to insure that sanitary waste does not enter the Thames River. Increased federal and state funding will be necessary to insure the success of this program.

In Subregion 3, the Quinnipiac River has a water quality limited segment. The condition of the water there precludes attainment of the water quality standard even if all point sources provided the levels of treatment required under federal guidelines. Unacceptable levels of dissolved oxygen are found and coliform bacteria levels are exceeded. Currently, the secondary effluents of the municipal plants at Meriden, Wallingford, and North Haven exceed the assimilative capacity of this river during periods of low flow. During periods of rain or snow melt, large amounts of sediments and nutrients enter the river through storm drains. The Connecticut Department of Environmental Protection has ordered the towns of Meriden and Wallingford to expand municipal secondary wastewater treatment facilities. The state envisions eventual advanced treatment at Southington and Cheshire, as well, and various land management programs along the river to achieve water quality goals.

Primary effluents from the New Haven treatment plants, combined sewer overflows, and urban runoff prevent the achievement of the water quality goals in New Haven Harbor. These sources result in unacceptable solids and coliform levels. Branford Harbor is affected by eutrophication and low dissolved oxygen problems. The major source of nutrients for the algal blooms appears to be the Branford waste water treatment plant. The state has ordered that this facility be expanded so that it may better treat its flow. Upgrading the plant to advanced treatment or relocation of the plant outfall is also being considered.

Bridgeport Harbor is a water quality limited segment where nutrients, coliform bacteria, solids, and oxygen-demanding materials prevent achievement of water quality standards. The major sources of pollution in Bridgeport Harbor are the overflows from combined sanitary and storm sewers and urban runoff. The city of Bridgeport has considered a deep tunnel storage and auxiliary treatment system to correct combined sewer overflows. Consideration is now being given to other stormwater storage possibilities. When there is a solution to combined sewers, and land management measures have been enacted to control urban runoff, it is expected that Bridgeport Harbor will meet water quality goals. The state has conducted intensive monitoring in Bridgeport Harbor and is in the process of analyzing the data to develop input for solving the Bridgeport Harbor water quality problems.

The lower Housatonic River, below the Derby Dam, is a water quality limited segment. The combined sewer systems of Derby and Shelton, in combination with runoff from these urbanized areas, result in unacceptable levels of coliform bacteria, solids, and oxygen-consuming materials. Shelton and Derby will undertake some sewer system improvements as treatment plants are upgraded, and when the combined sewer overflow problems are fully corrected, it is expected that the lower Housatonic will meet and maintain water quality standards.

Norwalk Harbor, like Bridgeport Harbor, is a water quality limited segment with combined sewer overflow problems. Levels of solids, oxygen-consuming waste, and coliform bacteria are beyond the acceptable standards. Norwalk is currently designing a supplemental treatment plant with microstraining and chlorination process to treat water overflows. When construction of the supplemental plant is complete, Norwalk Harbor should meet and maintain the water quality standards.

Western Long Island Sound includes the open waters and embayments bordered by Westchester County on the north, New York City on the west, and Nassau County on the south. Water quality in the Upper East River is very poor by all standards employed. It is directly affected by four municipal treatment plants, combined sewer overflows, and urban runoff. When East River water is diluted with water from Long Island Sound, persistent algal blooms occur and reach a maximum along the line connecting City Island and Execution Rock, slightly east of the New York City line. Also affected by algal blooms are Little Neck Bay, Manhasset Bay, Hempstead Harbor, and Oyster Bay on the north shore of Long Island.

What can be done to solve the problems?

Although many pollution abatement programs will be recommended by this study, almost all are the direct result of mandated improvements and ongoing enforcement and planning activities of New York, Connecticut, and the

federal government. Both existing plans and new alternatives were considered. The Long Island Sound Study primarily offers the citizen and decision maker the opportunity to see all the present and future pollution abatement programs explained and evaluated, individually, and as they are related to one another and to the solution of present and future water resource problems. The 1972 Federal Water Quality Amendments proclaimed the national goal of achieving water that is clean enough for swimming and other recreational uses, and clean enough to protect fish, shellfish, and wildlife (swimmable-fishable waters) by 1983. It further urges the elimination of pollutant discharges altogether by 1985. As an interim goal, the amendments require that existing federal and state water quality standards be met by 1977.

Within this framework, and considering the magnitude of the problems to be overcome, the following water management objectives were chosen:

1. Achieve and maintain swimmable-fishable waters throughout the study area;
2. Protect waters of existing high quality from degradation;
3. Provide sufficient supplies of potable water to meet demands.

Programs to achieve these objectives have been evaluated against a total of forty-eight criteria for environmental, economic, and social feasibility and desirability.

Nearly seventy different programs or techniques were considered and evaluated. For pollution abatement they are grouped by pollution source. See Table 2.I-3 for the complete list. Many of the alternatives are incompatible with others in their grouping. The recommended plan must, therefore, choose the optimal combination of alternatives to solve the problems and satisfy the objectives.

Municipal wastes. The four major facets of concern in correcting pollution from municipal sources are: 1) sewers, 2) treatment plant construction, 3) effluent disposal, and 4) sludge disposal.

With the possible exception of transportation facilities and highways, sewer lines are unmatched for their impact on the timing and location of urban growth. There are two broad approaches for sewering within the region. They are: (1) the do nothing approach, and (2) utilizing the timing and placement of sewer lines to direct urban growth and promote high quality development where appropriate. The do nothing approach is exemplified by many communities in the Sound region where septic tanks have been installed at too high a density, causing contamination of the ground water. Now that roads and homes are already built, sewering costs are higher, as well as the social disruption caused by the construction. The planned development approach is embodied by the *Connecticut Plan of Conservation and Development.*

This plan attempts to identify areas throughout the state that have varying degrees of opportunities for, or limitations on, future urban development, as related to water quality, as well as social, economic, and other environmental considerations. It demonstrates how sewering can be used as a tool to promote staged, contiguous urban development without many of the environmental problems created by urban sprawl.

The 1972 Water Pollution Control Act Amendments require secondary treatment of all municipal wastes by 1977, and "best practicable" treatment by 1983. The selection of the best practicable treatment method is governed by cost-effectiveness as well as general environmental considerations, such as the characteristics of the receiving water. Secondary treatment may qualify as best practicable in areas which do not have severe water quality problems, and is generally the most cost-effective approach for dealing with biochemical oxygen demand (BOD) and solids. Higher levels of removal of these two pollutants are best attained by control and treatment of combined sewer overflows and urban runoff. Higher levels of treatment in municipal plants are more properly focussed on nutrient removal, either nitrogen or phosphorus, where eutrophication or algae blooms are particularly severe. Nutrient removal, however, considerably increases capital and operating costs and the volume of sludge.

All of the major municipal treatment plants today discharge their effluent to water, either a river, a bay, or the Sound. The ability of the receiving water to assimilate the municipal discharge depends, in part, upon its flow or flushing characteristics and the extent of additional loadings on it. In the case of bays and harbors, the assimilation capacity varies and the elimination of waste disposal may or may not make an appreciable difference in water quality.

The land disposal and direct reuse alternatives apply primarily to areas where ground water recharge is desirable or the receiving water simply cannot assimilate the effluent, thus denying other uses of the water. There are several techniques of land disposal: irrigation, modified streams, high rate infiltration, and overland flow. Irrigation is the most widely used type of land application. For Long Island, disposing of advanced treated effluent by irrigation would require 72,000 acres by the year 2020. This is 21 percent of the vacant and farm land existing in 1968. Furthermore, not all of this land is suitable for land disposal. In view of the high cost of land on Long Island, the cost of such a system would be prohibitive. Another major disadvantage of irrigation in the study area involves climate and geography. Irrigation cannot be used during the winter when the ground is frozen. Consequently, large storage lagoons and/or outfalls would be needed to store and/or dispose of winter flows. The geographical factor involves the cost of transporting the effluent from the treatment plants to the irrigation area. Irrigation of either secondary or advanced effluent, however, presents definite possibilities and could be used on a smaller scale in parts of Suffolk County, not only to treat wastewater, but also to preserve open space.

The modified streambed method of effluent disposal involves discharge to the heads of ground water-fed streams. This would maintain the flow downstream and possibly

TABLE 2.1-3 Alternative Water Management Measures

I. Municipal Point Sources

A. Sewering
1. Do nothing
2. Planned development

B. Treatment measures
1. Less than secondary treatment
2. Secondary treatment
3. Best practicable treatment

C. Wastewater effluent disposal
1. Long Island Sound disposal
2. River disposal
3. Embayment disposal
4. Land disposal
5. Direct reuse

D. Sludge disposal
1. Use as soil conditioner or fertilizer
2. Landfill
3. Incineration
4. Wet oxidation
5. Long Island Sound disposal

II. Industrial Sources

A. Industrial treatment
1. Best practicable treatment
2. Best available treatment

B. Joint treatment

C. In-process changes

III. Combined Sewer Overflows

A. Do nothing

B. Sewer separation

C. Control measures
1. Regulator maintenance
2. Use of improved regulations
3. Control of infiltration/in-flow
4. Computerized control

D. Treatment measures

E. Storage

IV. Non-point Sources

A. Land use controls
1. Guiding growth
2. Preservation of environmentally critical areas
3. Critical use siting

B. Land management practices
1. Street cleaning
2. Erosion & sedimentation controls
3. Porous pavement
4. Minimize use of highway salts, fertilizers & pesticides
5. Abatement of animal waste runoff

V. Watercraft Waste

A. Fuel recycling devices

B. Domestic wastes
1. Holding tanks & pumpout facilities
2. Flow-through devices

VI. Oil and Hazardous Materials

A. Establish sea lanes

B. Train personnel

C. Use containment equipment

D. Licensing requirements

E. Offshore oil transfer

F. Consolidation of ports

VII. Dredging & Disposal of Spoils

A. No dredging

B. Treatment of spoils

C. Open water disposal

D. Land disposal

E. Incineration

F. Creation of artificial habitats

VIII. Water Supply

A. Surface water development
1. Expand reservoirs
2. Develop high flow stream diversion facilities
3. Construct water treatment facilities

B. Groundwater development
1. Develop safe yield
2. Mine groundwater
3. Employ recharge

C. Other proposals
1. Import water
2. Interconnect water systems
3. Desalination
4. Direct reuse

D. Water conservation
1. Increased pricing
2. Plumbing controls
3. Zoning to limit growth

E. Do nothing

provide some recharge of the ground water. Advanced treatment would be required to prevent degradation of the stream's water quality. On Long Island this procedure would have merit for a small portion of the total waste water discharge.

High rate recharge, either infiltration-percolation or deep well injection, could be an efficient means of ground water recharge. On Long Island, loading rates up to 400 feet-per-week have been recorded in storm water basins. A recharge research project in Suffolk County has been proposed in which loading rates for effluent would be up to 200 feet-per-week. Land costs would be relatively low, but advanced treatment, including nitrogen removal, would be necessary.

Direct reuse of properly treated wastewater offers the benefits of protection of aquatic life, improved water quality, conservation of drinking water supplies, and additional recreational opportunities. The primary disadvantages are the possibility of health hazards and the cost, because advanced treatment is usually required. Although not presently recommended as a municipal water supply source, direct reuse may be practical for agricultural or industrial needs. The primary concern with the use of reclaimed water for irrigation has been the possibility of health hazards from effluent contact with crops consumed directly by humans. Industrial use of reclaimed water has little potential for water conservation on Long Island, simply because few major water-consumptive industries locate there to begin with. However, in Connecticut, industrial reuse can provide a practical way to cut industrial water consumption and thus increase drinking water supplies.

Sludge disposal problems have been neglected for too long, although sludge handling and disposal represent 25 to 50 percent of the total capital and operating costs of a treatment plant. The use of sludge as a fertilizer or soil conditioner can provide substantial environmental, economic, and social benefits. The water, nutrients, and organic matter in sludge are used to increase the humus content, fertility, and water retaining capacity of the soil. It furnishes an alternative to the inorganic fertilizers, which have recently been diminishing in supply and increasing in cost. Since large buffer zones are needed for land disposal sites, parks and outdoor recreational areas can be preserved or created.

There are several potential hazards inherent in the land spreading of sludge. Sludges from most industrial areas contain significant amounts of toxics, such as heavy metals. The accumulation of these metals in the soil after many years of application could make it unfit for plant and animal life. Perhaps of more concern is the possibility of toxic metal buildup in the food chain if crops are planted which absorb relatively high amounts of metals. There is also the possibility of nitrates and other toxics contaminating the ground water if application rates are too high. Nevertheless, if caution is used when applying this technology, it can provide an environmentally beneficial solution to the sludge disposal problem.

The use of sanitary landfills for disposal of dewatered or incinerated sludge is common in the LISS region. If the landfill site is carefully selected and the operation is well run and carefully monitored, adverse environmental impacts will be minimal. This disposal method, however, does not take advantage of the nutrients in the sludge, nor is it a permanent solution. This costs more than land application of liquid sludge but about the same as land spreading of dewatered sludge.

No sewage sludge is currently dumped into the Sound or any water body in the study area. The potential hazards to marine life, water quality, and beaches dictate that this policy remain firm. New sludge handling and disposal technology will probably make advances in the years ahead, and less costly, more environmentally beneficial solutions will likely be developed.

Industrial wastes. Four broad approaches to abate industrial pollution can be employed: (1) an industry can treat its wastes and discharge effluent to a water body or land disposal site; (2) an industry can discharge its wastes to a publicly owned treatment plant; (3) an industry can discharge to regional industrial waste treatment plants; or (4) the industrial process itself may be altered to reduce wastewater discharges. For the first approach, the federal law requires the best practicable treatment (BPT) by 1977 and best available treatment (BAT) by 1983. Both BPT and BAT are partially based on an economic evaluation of alternative pollution control measures. Adverse economic impacts to the industry, region, or nation should be minimal, although some marginal operations already in financial jeopardy might be forced to close. BPT is quite stringent and usually produces an effluent quality that is as good or better than municipal secondary treatment. The higher levels of treatment required by BAT is, for some industries, a closed cycle, no discharge system, with ultimate disposal of sludges remaining as a possible problem.

The high costs of meeting these requirements induce many industries to tie into a municipal treatment system and/or conserve water through modification of processes. Joint treatment of municipal and industrial wastewater can often be mutually beneficial and improve water quality. Pretreatment is required of industrial wastes which might be incompatible with the municipal treatment process.

Combined sewer overflows. Unless combined sewer overflows are abated, the Thames River, the lower Housatonic River, Norwalk River, New Haven Harbor, Bridgeport Harbor, and much of western Long Island Sound will not attain the targeted water quality standards. For years, sewer separation had been considered to be the only real solution to this problem. Recently, however, studies have revealed that sewer separation is not usually the best alternative. An EPA study[3] indicates that, with separation, the reduction in wet-weather pollution would be only 50 percent because

[3] *Op. Cit.*

of the poor quality of the untreated urban storm runoff. Sewer separation can cause enormous social disruption and generally costs more than other alternatives. In small communities with minor combined sewer problems, separation may be warranted. It should, however, be emphasized that storm water runoff itself can be a significant pollutant, and in the future it may be necessary to collect and treat storm sewer discharges.

Measures to control or minimize combined sewer overflows, in order of ascending cost, are regulator maintenance, use of improved regulators, control of infiltration and inflow, and computerized system control. Techniques still in the experimental stage include flushing the sewers during dry weather, and polymer injection. Injecting polymer-gelled slurries into sewage reduces hydraulic friction substantially and has provided temporary increases in sewer capacity up to 144 percent.[4] This is particularly important in storm water drainage systems, because sewer surcharges are short-term.

An increasingly popular means of controlling combined sewer overflows is to install level sensors, rain gauge networks, sewage and receiving water quality monitors, overflow detectors, dynamic regulators, and flow meters, and then apply computerized collection system control. Such a system is designed to make the most effective use of interceptor and line capacity by routing and storing combined sewer flows. The computer controlled system allows an operator to divert flows and utilize all available in-system storage. Noticeable improvements in water quality have been achieved in Seattle and Minneapolis-St. Paul since they instituted such systems. This type of system is also much less expensive than sewer separation and individual components can be installed as funds become available.

In the LISS region, treatment of combined sewer overflows will probably be necessary to meet water quality standards. The decision to use centralized or dispersed treatment facilities depends on local conditions. Most treatment methods can be used effectively at either a centralized location or at individual outfalls. Biological treatment techniques are an exception because of their vulnerability to shock loadings, and are generally located at a centralized site where they can be preceded by surge chambers to equalize flow.

Storage is the best documented combined sewer abatement measure currently in practice. Storage facilities offer many advantages: (1) they are simple in design and operation; (2) they respond without difficulty to intermittent and random storm behavior; (3) they are capable of providing flow equalization; and (4) they can frequently be used in conjunction with regional treatment plants to offer both dry and wet weather benefits. Major shortcomings of such facilities are their cost, visual impact, solids disposal problems, and large size.

These various alternatives that have been discussed for abating combined sewer overflows are not singular solutions. A cost-effective solution to storm water runoff and combined sewer overflows requires that these methods be combined to optimize the effectiveness of any overall pollution abatement program. Wherever possible, there should be multiple use of overflow facilities. Storm water treatment facilities can be used as effluent polishers, and storage devices can be used to reduce the rate of flow, allowing reductions in the size of the required treatment facilities. Improved regulators and remote monitoring control systems increase the effectiveness of the entire sewerage system. By integrating storm water abatement facilities with existing or proposed sewage collection systems and treatment plants, the overall cost of constructing and operating waste water facilities can be reduced.

Non-point sources. Control of non-point sources of surface water pollution falls into three categories: land use controls, land management practices (reduction of runoff pollution), and air pollution controls. Land use measures should emphasize preservation of natural filter systems, such as flood plains, wetlands, and vegetative covers, which reduce the amount or impact of pollutants reaching open waters. Such preservation also benefits fish, wildlife, and recreation, and reduces flood damage and erosion. Dumps and landfills along the shoreline and streambanks should be relocated. Land use measures should also assure public access and a scenic setting for enjoyment of the resources which the public has paid so much to enhance.

Land management programs designed to reduce runoff erosion and sedimentation, as well as water pollution from non-point sources, should be undertaken in several parts of the region. In the Quinnipiac River valley, land management could significantly aid in achieving water quality goals. Specific land management measures are discussed in Section 2.11 Erosion and Sedimentation.

Non-point pollution of ground water is caused primarily by septic tank effluent, land application of a number of chemical compounds, including fertilizers, de-icing compounds, pesticides and herbicides, inadequate storage and disposal techniques for toxic substances, and salt water intrusion. Programs to control ground water pollution have been instituted on Long Island. In Connecticut, widespread control measures have not been undertaken because known occurrences are small and localized, and the region is not as dependent on ground water.

Oil and other hazardous materials. Although the key federal and state agencies all have contingency plans in case of oil or other hazardous material spills, the major emphasis on controlling this pollution must be prevention. Containment and cleanup is of very limited effectiveness, especially in open water, and is extremely costly. If the study's marine transportation proposals for consolidation of ports are implemented, there will be much larger tankers using the Sound. Under these conditions, it will be imperative that spills be minimized and that all crews involved in delivery and distribution of oil and other hazardous materials be well trained in spill prevention and

[4] Lager, John and Smith, William, *Urban Stormwater Management and Technology: An Assessment*, EPA, Dec. 1973 (draft).

cleanup.

Establishment of federal sea lanes and additional navigation aids would improve safety and reduce the chances of groundings or collisions. The requirement that an English-speaking person or translator be on board any tanker entering the Sound to assure clear communications might eliminate another cause of spills.

The use, not simply the availability, of spill containment equipment during all transfer operations, and more frequent state inspection of transfer procedures and equipment should be implemented.

Watercraft waste. Vessels can, and commonly do, discharge unburned fuel as well as human wastes to the Sound. Study estimates indicate that, in an average year, recreational boats in the Sound may contribute more oil from the exhaust of two-cycle engines than oil spills do. Since these boats are often operated or moored near marshes, productive shellfish beds, and beaches, it is essential that this pollution be minimized or stopped. Fuel recycling devices are available that save valuable fuel resources and often pay for themselves in just one season. Manufacturers are presently installing these recycling devices on all new two-cycle engines voluntarily.

Domestic waste pollution can be controlled through either an onboard treatment device or a holding tank with subsequent pumpout and treatment at onshore facilities. Existing federal standards seek no discharge as an ultimate goal and would become effective after promulgation of Coast Guard implementation regulations. New vessels would then have two years to install a holding tank or other zero discharge device. Existing vessels, however, could, within five years, install a certified flow-through treatment device. If the device were installed in the first three years, it could be used for the life of the boat, as long as it operated properly. Any existing vessel without a certified treatment device after five years would have to install a holding tank.

In addition, both states should survey the coastline to determine areas where both boats and swimmers congregate, and where boat buildup of pollution may be a problem in summer months. These areas should be considered for addition to the non-degradation zones being established by the states, and regulations for enforcement should be drawn up and implemented.

Dredging and disposal of dredge spoils. Alternatives to reduce the impact of dredging and spoil disposal focus on either reducing or eliminating the need for dredging, or mitigating its environmental impacts. These alternatives are developed and evaluated in Section 2.6 Marine Transportation, and include no dredging, offshore berths, and other navigation-related alternatives.

A number of ways are available to mitigate the environmental impact of dredging. Treatment of polluted dredge spoils before dumping is possible, but may be expensive. Dredge spoils may be disposed of on land, but this has the potential of creating public health hazards or water pollution if toxics and other pollutants are present. Incineration can be used, but it may cause unacceptable air pollution. An innovative approach to the spoil disposal problem is the use of dredge spoils in the creation of new wetlands and artificial islands. The cost of creating these lands would be comparable to that of acquiring these scarce resources. See Sections 2.3 Outdoor Recreation and 2.4 Sport Fisheries and Wildlife for further details.

Little is really known about the long-term cumulative effects of spoil disposal on marine life in the Sound. Monitoring of the effects from the recent New Haven maintenance and New London deepening projects should be continued until meaningful results are obtained. (The Thames River dredging project can be terminated at Connecticut's request, according to the Connecticut Department of Environmental Protection.) Any other major project should be delayed, if possible, until the findings of these two monitoring programs are available. Based on these studies, necessary safeguards can be established for treatment and disposal of polluted spoils. In some cases, this may require both treatment and disposal outside the Sound, despite the added costs.

Water supply. The water supply alternatives in this report focus on four ways of meeting needs: (1) develop surface water sources within the region; (2) develop ground water sources within the region; (3) import water to the region; and (4) limit water use through conservation means.

Connecticut generally has enough water to supply its forseeable needs, provided there is some greater regionalization of suppliers to make efficient use of the resources, and potential surface and ground water sources are protected.

The state *Plan of Conservation and Development* provides sound guidelines for protection and the orderly development of future sources. The plan advocates the development and use of ground water, in most areas, prior to any new surface water sources. Most proposals in this plan appear to have minor environmental impact. A significant exception is diversions which reduce downstream flow and thereby possibly harm water quality, fish and wildlife habitat, and scenic beauty. Diversions should only be used if no other practical alternative is available and environmental impact can be minimized.

In southwestern Connecticut, if there is continued heavy population growth, small water supply projects within the study area will not provide sufficient supplies. Therefore, projects outside the study region might well be needed to serve this area some time after 1990. Proposals prepared by the U.S. Army Corps of Engineers and the Bridgeport Hydraulic Company call for development of the Housatonic River with off-stream storage as the major water supply project (160 million gallons per day) to meet the additional needs of the area. However, this proposal is contrary to present state law and policy, which prohibit the taking of drinking water from any stream or other source which receives wastes, treated or untreated. Wastes are currently dumped into the Housatonic River at several points along its course. The proposal might also conflict with intensive recreation use of these waters. The state is currently reviewing a number of smaller projects which they feel will

provide enough water to eliminate the need for using Housatonic water. Future technological advances in water treatment may permit the state to amend its laws and permit use of such water sources as drinking supplies.

New York has an entirely different water supply situation. Westchester County receives most of its supply from the New York City system, which imports its water from upstate and out-of-state surface water sources. Since their supplies do not have an appreciable impact on Long Island Sound, and since most of the supplied population lives outside the region, consideration of how to satisfy their water supply needs was not included in this study.

In sharp contrast to the rest of the region, Long Island is almost totally dependent on ground water. Water conservation practices, recharge of treated waste water, and importation of water are the most practicable and viable alternatives available to Nassau County to meet its water supply needs. Other methods, such as desalination and weather modification, are not presently economically or technically considered feasible.

Various methods of desalination were studied by the staff of the Temporary State Commission on the Water Supply Needs of Southeastern New York. It was concluded that, while technically feasible, the cost of desalination is not competitive with traditional means of water supply. The by-product of the desalination process would be large amounts of brine, the disposal of which would pose environmental difficulties. A further constraint is the lack of experience with large desalination plants. Existing plants are of rather small scale, generally on the order of 1 or 2 MGD capacity.

Importation of water from Suffolk County may not be possible politically at the present or in the foreseeable future and the only other possible water source is the New York City system. Assuming that the institutional arrangements can be worked out, the transmission capabilities for supplying Nassau County could not be available until at least 1985.

Recharge of renovated wastewater has been studied at Riverhead and Bay Park, Long Island, on a limited scale. A full-scale demonstration project is necessary before any large-scale ground water recharge can be undertaken. A 5-MGD project proposed for Wantagh appears to be the logical next step. The project has not been funded, but assuming that the funds to finance this project become available, it would take about six years to complete construction and gain the necessary experience to obtain meaningful information. Large-scale ground water recharge, on the order of 70. MGD, as recommended by the Temporary Commission, does not appear likely until after 1985.

At present the best water management alternative available to Nassau County is a program of water conservation. Nearly all of the publicly supplied water in Nassau and Suffolk Counties is already metered, so that metering cannot be used as a conservation measure. Leakage control programs, use of water saving devices, long-range and wide-spread education programs, revised water pricing structure with penalties for excessive consumption, and possibly an expansion of the presently practiced storm water recharge program would have measurable impact. During times of drought, additional, more stringent measures—such as restrictions on unnecessary water use—could be imposed.

Recommended Plan

The water quality portion of the recommended plan will provide for swimmable-fishable waters by 1990 throughout the study area and preservation of existing high quality waters. The plan emphasizes "best practicable treatment" for municipalities; "best available treatment" for industries; elimination of combined sewer pollution; establishment of selected non-degradation zones; land management measures to reduce non-point pollution, especially from urban areas, construction activities, and solid waste disposal areas; development of a comprehensive program to mitigate environmental effects of dredging and disposal in the LISS area; prevention of oil spillage; and uniform requirements for sanitation devices for watercraft.

Figure 2.1-2 is a flow chart of the short-range water management program, with the suggested optimum time frame to achieve the objectives. Figure 2.1-3 is a map of the proposed water quality.

Budget limitations, however, are likely to make parts of this program unattainable. A recent survey prepared by the states estimated the cost of achieving the goal of swimmable-fishable waters nationally at $350 billion by the year 1990. Anticipated levels of funding are not expected to approach this figure. Therefore, in a limited number of highly degraded urban harbors and rivers, both within and outside the study area, the goal of swimmable-fishable waters will probably not be achieved.

If funds are not sufficient to reach these goals, the limited financial resources should be invested in abatement efforts that are directed toward either providing significant short-term water quality improvements, preventing serious degradation or a public health nuisance, providing restoration of an entire riverine or estuarine system, or allowing new public uses of the water, such as swimming or shellfishing. Any measures being considered would also have to be evaluated for economic acceptability, with the state probably making a decision on funding priorities.

Completion of the secondary treatment program, and reduction and treatment of combined sewer overflows seem to be the most immediate priorities. Although both of these programs are quite expensive, the present level of federal funding for sewage treatment would be sufficient to complete them both by 1985, except in New York City, where, without a substantial increase in funding, some compromise solution to their combined sewer pollution problem would be necessary. While these programs are being implemented, future restoration priorities should be

FIGURE 2.1-2 Short Range Water Management Program for Long Island Sound Region

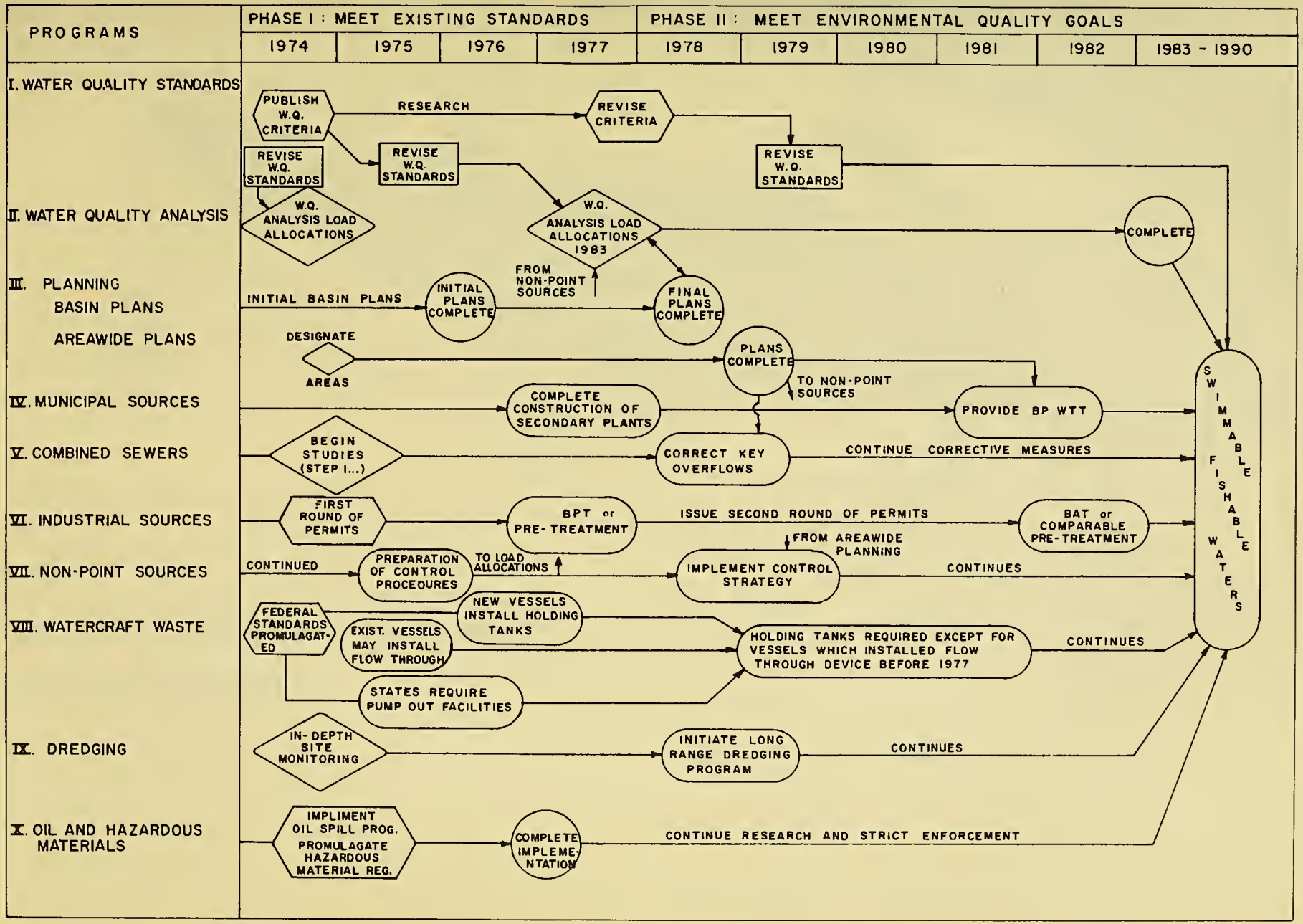


FIGURE 2.1-3 Proposed Water Quality—1990

resolved and water quality goals modified. Not all of the water cleanup program is expensive, however. The designation of non-degradation zones to protect existing clean water, and the recommended measures to control dredging and prevent oil spills all involve little direct cost. These measures can and should be implemented promptly.

The water supply portion of the plan emphasizes regional systems for greater flexibility and reliability; conservation of water in Nassau County until recharge on a large scale is technically feasible; and development of new and expanded supplies in keeping with land use policies to protect and conserve the water resources.

The specific recommendations are presented in the 16-point program below. Local projects are listed in the subregional chapters.

Water Quality

1. **Federal funds** should be increased immediately to insure that no municipal wastewater discharges reach Long Island Sound with less than secondary treatment after 1980. Costs eligible for state and federal funds to complete this portion of the water management program are approximately $280 million for Connecticut and $340 million for New York.

2. **Abatement of combined sewer pollution.** Adequate federal funds should be made available to minimize pollution from combined sewer overflows by 1985, immediately after completion of secondary treatment works. This program can take place in phases, but the emphasis in most cases should be on storage and treatment of overflows, rather than sewer separation.* During the initial phase, improved combined sewer operation can be obtained by repair of sewers and bypass regulators and reduction of peak stormwater flows, by improving waste water system usage and decreasing infiltration. Also during this phase, additional information about the combined sewer systems should be gathered.

During the next phase, further improvements can be implemented by using a combination of control, storage, relief sewers, treatment, and separation. As funds become available, individual components can be selected. Probable costs to complete this program are on the order of $2 billion in New York and $200 million in Connecticut.

3. **Study of nutrient enrichment in western Sound.** New York State Department of Environmental Conservation should identify western Long Island Sound as water quality limited and initiate a special study of the area to determine whether nutrient removal at municipal waste water treatment plants will be necessary to attain water quality goals. The study should also determine the relative significance of point and non-point sources of pollution coming from the Upper East River, Westchester County, and Nassau County. Pollution abatement priorities, after secondary treatment at municipal treatment plants, should be established, and a plan for financing all elements of the treatment system developed.

4. **Non-degradation zones.** States should be required to designate, through public hearings, selected streams and estuarine areas, which presently have excellent water quality, as non-degradation zones, to prohibit both additional point and most non-point sources of pollution, in order to preserve fish, shellfish, and recreational waters, and guarantee non-degradation. Examples include the Niantic River, Poquonock River, and Mt. Sinai Harbor. Additional areas which deserve protection are identified in Section Three: The Plan by Subregion. In other high quality areas, the states may allow discharges only if the effluent is at least equal in quality to that of the receiving water.

The federal Environmental Protection Agency should develop national guidelines on non-degradation to assist the states in their definitions and control strategies, and to standardize the criteria for non-degradation.

5. **Dredging policy.** As part of their coastal zone management programs, New York and Connecticut should strengthen their present memorandum of understanding on dredging, by assigning permanent dredge spoils disposal sites, establishing the quantity of dredge spoils to be dumped at these sites and, together with the Environmental Protection Agency, the U.S. Army Corps of Engineers, and the National Oceanic and Atmospheric Administration, establishing dumping procedures to lessen the environmental harm and monitoring programs to determine the long-term effects of these activities.

The Corps of Engineers should begin feasibility studies immediately on the treatment and use of solid waste and dredge spoils to build artificial islands in the Sound for recreation and other purposes.

6. **Reduce oil pollution.** To reduce the frequency and severity of spills from petroleum handling operations:

(a) Consolidate petroleum receiving facilities and operations in five ports—New London, New Haven, Bridgeport, Port Jefferson and Northville—to reduce the number of vessels and oil transfers and utilize improved equipment. Operations in all other locations, except for residual oil traffic, should be phased out over an extended period.

(b) Develop offshore receiving terminals at New Haven and Port Jefferson by 1985 and Bridgeport by 1990, with submarine pipelines to shore.

(c) Encourage full use of existing pipelines for gasoline and distillate oil from New Haven to Chicopee, Massachusetts, and from Port Jefferson/Setauket south to Holtsville and west to Plainview. New "clean" product lines should also be built, including extension of the Holtsville-Plainview section east to Northville and west to mid-Nassau County by 1980; a second line from New Haven north to the Hartford area by 1990; and a new line from Bridgeport to the Bronx by 1995. In addition two new "hot lines" to carry residual oil from New Haven to Middletown and from Bridgeport to Devon

*It should be noted that the study's Coordinating Group concurred in this recommendation, although the State of Connecticut specifically withheld its endorsement.

should be built by 1985.

Each of these measures should reduce the number of vessel trips and oil transfers required, particularly in the fragile enclosed bays and rivers in the region. Further details are included in Section 2.6 Marine Transportation.

(d) Enact federal legislation to require licensing of all key crew members whose ships are used for hauling or pushing tank barges loaded with oil or other hazardous materials.

(e) Provide increased funds and staffing on both the federal and state levels in order to implement and enforce existing legislation dealing with oil and other hazardous materials. Such legislation includes: (1) strict liability without fault of spiller for damages to any person and penalties up to $5,000 for each day that a violation continues; (2) continuous surveillance of oil spills by the Coast Guard; and (3) Coast Guard regulations which prohibit the discharge of oily bilge water from any vessel over twenty-six feet in length.

(f) The Coast Guard should establish sea lanes to the major ports in the Sound.

(g) States should require that spill containment equipment be available in each receiving port, and in use during all transfer operations.

Measures (d) through (g) should be implemented by 1977.

7. **Non-point pollution control.** The Environmental Protection Agency should continue to conduct research and demonstrations on non-point sources of pollution and their control. The states should identify, monitor, assess, and predict the nature and extent of non-point source pollution, particularly in the most severely polluted water bodies. By 1977, non-point source control should become a major program emphasis. The programs, using a combination of land use controls and land management practices to protect vulnerable waters and reduce runoff, erosion, and sedimentation, should be tailored to local conditions.

8. **Land fills and dumps.** The states, through their respective, ongoing solid waste recovery and management programs, should assure that the effects of dump and landfill leachates on the Sound are minimized by 1977. Open dumps and landfill operations on the shore should be terminated as soon as suitable alternative upland sites become available.

9. **Vessel wastes.** The federal Environmental Protection Agency and the Coast Guard should immediately put into effect standards and regulations for vessel wastes which require holding tanks or other certified discharge devices on new vessels two years after the regulations go into effect. On-board certified, flow-through treatment devices would be permitted on existing vessels for the duration of their lifetime, if they are installed within the first three years. Connecticut and New York must ensure that adequate pumpout and treatment facilities are available. See Section Three: The Plan by Subregion for recommended new locations. A reasonable pumpout fee should be charged. Once implemented, the Coast Guard, states, and local police patrols on the water should make spot checks in the same way they now inspect for required flotation devices.

In addition, both states should survey the coastline to determine areas where both boats and swimmers congregate, and where boat buildup of pollution may be a problem in summer months. These areas should be considered for addition to the non-degradation zones being established by the states, and regulations for enforcement should be drawn up and implemented.

Water Supply

10. **Nassau County water needs.** Nassau County should establish water conservation programs immediately, including more stringent emergency programs in case of drought. Measures such as leakage control programs, use of water saving devices, long-range and wide-spread education programs, revised water pricing with penalties for excessive consumption, and possibly an expansion of the presently practiced storm water recharge program ought to have measurable impact. During times of drought, more stringent restrictions on automobile and street washing and watering lawns could be imposed. Simultaneously, Nassau County, with state and federal Environmental Protection Agency assistance, should vigorously pursue ground water recharge demonstration projects and follow-up programs to preserve both the quality and quantity of the ground water as its long-term supply source. Existing county sewering plans should be implemented as well. But importation of water from outside the county will also be required, at least during some drought years in the future.

11. **Protect Upper Housatonic River.*** Connecticut, together with the U.S. Army Corps of Engineers and federal Environmental Protection Agency, working through the Corps' Urban Waters Study for the Housatonic, should continue investigation of the feasibility of using the Housatonic River, Candlewood Lake, and the Lake Lillinonah complex as a major water supply source for southwestern Connecticut. Development of this source would be contrary to present state law which prohibits the taking of drinking water from any water body receiving wastes, treated or untreated. It might also conflict with intensive recreation use of these lakes and the river. The potential magnitude of the project, however, necessitates an exhaustive study before dismissing the possibility. Use of this source would require (1) a change in state law and policy; (2) improvement of water quality; and (3) resolution of legal problems in the use of the reservoir and water rights for providing public water supply.

In any event, state identified upland surface and ground water sources should be carefully protected.

12. **Regional systems.** State and local governments should encourage development of regional water supply systems,

*It should be noted that the study's Coordinating Group concurred in this recommendation, although the State of Connecticut specifically withheld its endorsement.

where economically feasible, to provide greater flexibility and reliability in provision of water. Further interconnections between water systems should be constructed for the same reason.

13. **Development of new and expanded supplies.** State, regional, and local planning agencies should adopt land use policies and regulations to protect and conserve potential new and expanded water supplies from unwise development.

Water Quality and Supply Management

14. **Areawide waste treatment management planning ("208") programs.** Areawide approaches, linking groups of communities together, should be advanced by each state through establishment of areawide water management programs, which could implement many of the recommendations in the water supply and quality program areas. Nassau and Suffolk Counties have been designated for an areawide program under the direction of the Nassau-Suffolk Regional Planning Board. Primary consideration for additional districts should be given to the communities bordering the Thames River, New Haven, and the other communities bordering the Quinnipiac River, the Greater Bridgeport area, Westchester County communities and New York City.

15. **Trend monitoring programs.** The states and the Interstate Sanitation Commission should expand their existing monitoring programs immediately to include trend monitoring of cumulative pollution conditions throughout the Sound, stressing inorganic nutrients, organic pollutants, and trace elements, along with oceanographic factors that bear upon them. These programs would be useful in determining the flux of polluting conditions across critical boundaries of the Sound at Throg's Neck and the Race; in determining pollution abatement priorities as part of the water quality management programs; and in developing a long-range dredge and disposal program for the Sound.

16. **Coordinate pollution cleanup schedule for Long Island Sound.** The states and the federal Environmental Protection Agency, acting together and drawing on the area's professional and academic talent, should utilize an on-going continuing planning process as a systems approach to coordinate water quality management decisions and pollution abatement priorities for Long Island Sound, and to insure the attainment of water quality objectives for the Sound.

Land Use and Growth

Introduction

The Long Island Sound Regional Study is a water and related land resources study. The major focus of the study is the Sound. However, with few exceptions, the problems of the Sound have their origin on land.

Present land use patterns have resulted in the degradation of water quality: pollution from municipal and industrial sewers; from urban and rural land runoff during construction; from destroyed natural protective systems such as wetlands, flood plains, various natural vegetative cover, and tide flats and shallows, which, when undisturbed, reduce the impact of pollution.

Land use patterns reflect fundamental social values: *a market economy* in which land is a commodity to be bought and sold, for immediate use, investment, and speculation; *local government* empowered to establish land use regulations, presumably in a vigorous, consistent, and fair manner, in accordance with concepts of a public good; and a *social ethic* that nominally, at least, celebrates frugality and looks askance at waste. As elsewhere, the land use pattern in the study area is also the product of man's interaction with his physical, biological, and social environment.

The Setting

Although the Sound is only ninety miles long and at most twenty-one miles wide, it is an integral part of a much larger area. Its waters come from as far away as the headwaters of the Connecticut River, 400 miles to the north in northern New Hampshire. The Sound is affected by the development forces that shape the Atlantic seaboard megalopolis. That larger region now contains about 37 million people in a nearly unbroken urbanized belt extending from southern New Hampshire to northern Virginia.

The entire study area, except the two planning regions in eastern Connecticut, lies within what is generally considered the New York Metropolitan Region. Land use and development within the study area are best viewed in the context of the metropolitan region. The economic and cultural attractions of New York City have stimulated growth within the study area. Extensive development, especially since World War II, has occurred in response to continuing migration of residents, business, and industry from older city centers. Between 1950 and 1970, the population of the Sound area nearly doubled as the whole New York region grew and more people moved out of the cities into the suburbs.

Growth: Projections

Though recently reduced in response to the declining national birth rate, current population projections for metropolitan New York anticipate that a 1970 regional population of almost 20 million will rise to about 25 million by 2000 and level off at about 28 million thereafter. The Sound area's share of the larger metropolitan New York population is expected to remain virtually constant through the coming decades. Stated another way, the population of the Sound region will rise from 2.3 million in 1970, to more than 3.0 million in 2000, and to nearly 3.5 million in 2020, a 54 percent increase between 1970 and 2020. Principal growth is likely to occur in eastern Connecticut and Suffolk County.

Growth: Its Impact

The rate at which land is urbanized will depend on a number of factors: lifestyle preferences, energy supplies, and communication or transportation services. In the absence of any major state or nationwide policy changes to the contrary, development densities for the most part can be expected to stay low. Land consumed would be correspondingly high. Recent development of open land in the Sound area has occurred at an average density of 2,500 persons per square mile. By contrast, towns containing center cities have densities averaging 7,000 persons for each square mile of developed area. The average for the Sound

area as a whole, in old as well as new developments, is about 3,500 persons for each square mile of developed area. Figure 2.2-1 illustrates the amount of land that would be required *if* anticipated growth were to be accommodated at these low densities.

Historically this pattern of open land conversion to accomodate growth has often placed intolerable demands upon the region's local governments; its high contribution, water-related open land; and the shores of the Sound itself.

Local Government

Throughout the study area, there is pressure for a relaxation of local zoning controls to permit greater variety in residential densities and type of housing units. This pressure is generated not only by builders, but by would-be occupants of multi-family rental or condominium units. While some localities have resisted this pressure until now, the demand has not abated, and it seems only a matter of time before the resistance will crack under the weight of judicial decision or public protest.

In the past, higher densities have not always been used to create the best possible environments. Like their low density counterparts, developments marked by high density often fail to provide the amenities that are among the most desired features of both urban and rural life.

Expanding growth has created other problems for local governments. Urban deterioration within city or town centers is one. In many instances, urban decay is concentrated at the shoreline as industries have moved to suburban locations—often anxious to receive them for their potential contribution to the tax base—leaving behind outmoded buildings, rotting wharves, and polluted harbors.

High Contribution Open Lands

Contrary to popular impressions, there is a great deal of open land within the Sound area. Sixty-eight percent of the total land area is open, and 32 percent is developed in urban use. Much of the open land makes its greatest contribution to the public good in its present natural or other open condition. This is particularly true of lands which are influenced by or have an influence upon the region's water resources. These water-related lands are shown in Figure 2.2-2 and in the more detailed Land Use and Critical Natural Resources Map in Volume 1: Summary. They include:

- Lands whose usage is especially influenced by water: wetlands, stream belts, coastal flood plains, beaches, dunes, and bluffs.
- Lands whose usage has a strong influence upon water quality or supply: prime agricultural and forest lands, water supply lands, and prime aquifers.

Past urban development in the Sound area has often encroached on these high contribution lands without regard for their unique value or the special opportunities they represent. Development has also cut off visual and physical access to the shore of the Sound and the Sound itself, and threatens further destruction of the area's historic and cultural resources.

The development capability of such lands is limited for a number of reasons. Some are vital to the preservation of drinking water supplies. Others form part of the marine food chain or serve as wildlife habitats. Still others would be a threat to public health and safety if developed. The decision whether such lands are to be developed or preserved involves weighing the benefits of development against the benefits of preservation (or the costs of development).

The Shore of the Sound

The shoreline itself is a unique and largely unmanaged resource. More than 200 units of local, state, and federal government make the day-to-day decisions that affect it—often with conflicting goals. As a result, past development decisions have often failed to respect natural, cultural, and economic values of the shore.

Ports and a few industries, for example, require shorefront sites. But most industrial development today does not. Moreover, because of existing transportation facilities, shoreline configuration, and channel depth, only a few sections of the shoreline are suitable for these economically essential activities. These few sections are thus a singularly valuable regional resource.

These same shoreline sections are also attractive sites for other industries, including power plants and other industries that need water for cooling and prefer sites near the Sound, and industries that serve or are supplied by water-related industries, and seek locations near them.

The shorefront also includes extensive high-contribution open spaces, including wetlands and tidal marshes and flats. Apart from fairly extensive natural areas that should be preserved in their present state, maximum public benefit is derived from use of the shorefront of Long Island Sound for recreation and as an eye-pleasing contributor to the quality of life within and beyond the Sound region.

Many developed portions of the shorefront make a far smaller contribution to recreation and passive pleasure for far fewer people, than could be provided by more efficient patterns of use and development.

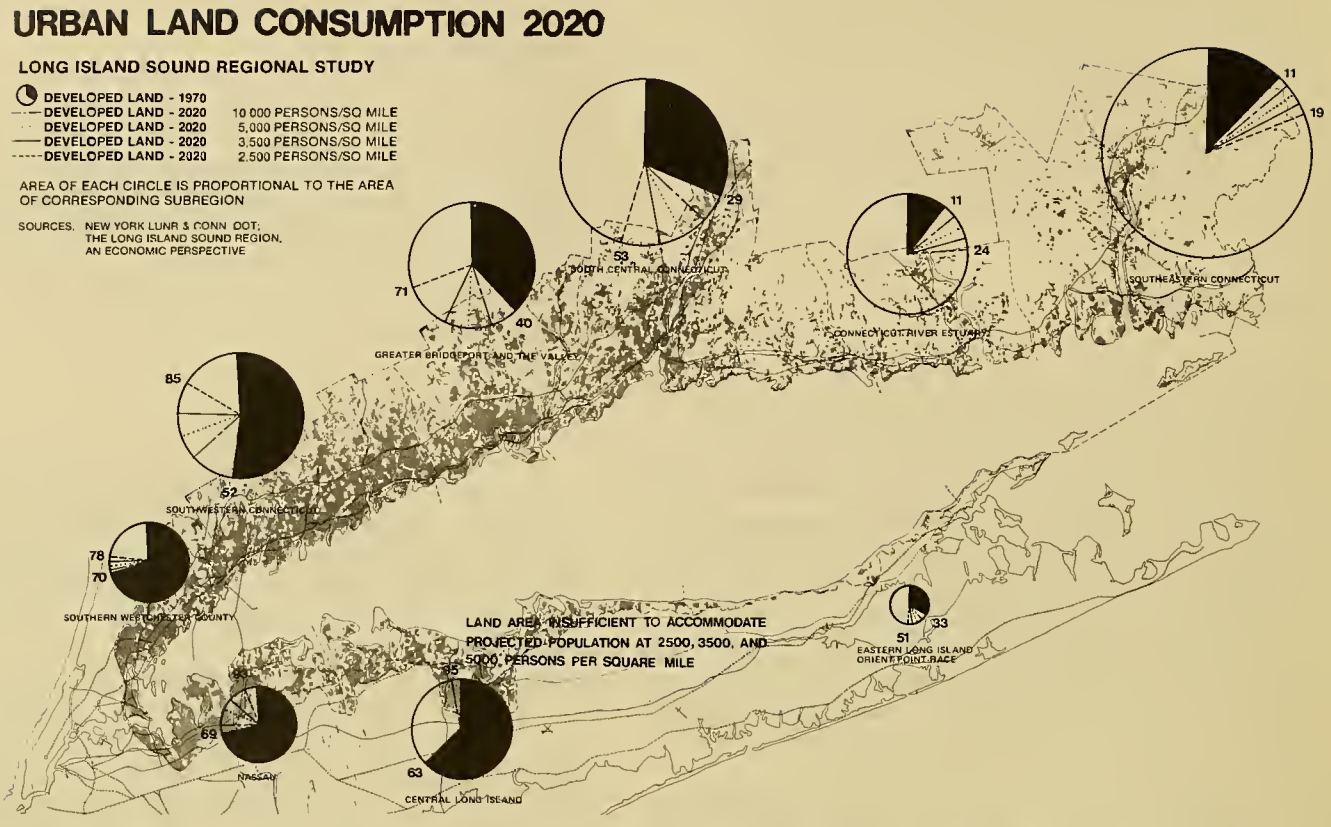
Only about 14 percent of the shoreline is devoted to public parks and recreation areas.

Of the publicly owned shorefront available for recreation, much is available only to residents of the town or county where it is located.

Of the privately owned shorefront, only a small proportion is devoted to commercial recreation facilities which enable the general public to enjoy the shore.

Public streets are seldom designed to provide and protect views of the Sound, thereby further reducing public awareness and enjoyment of it.

FIGURE 2.2-1 Urban Land Consumption—2020



Growth: the Response

If the nation or the New York region is viewed as a whole, population growth appears inevitable. It is conceivable, though by no means clear, that a national or regional growth policy would direct a smaller (or larger) proportion of anticipated population growth into the Sound area. At present, however, there is no explicit national or regional policy on population distribution, nor is there any national or regional consensus out of which such a policy seems likely to arise in the near future.

In the absence of a national or regional policy, local and state governments that resist population growth or economic development can only give negative responses to growth problems ("no growth in this community"), without providing the affirmative responses ("growth in that community instead") that must be given if growth problems are to be solved rather than merely avoided.

Some governments, responding to the wishes of their residents, may nevertheless resist growth, and the resulting growth restrictions sometimes may prove effective. Clearly, however, the curbs face formidable legal, administrative, and political obstacles. Moreover, if restrictions become so widespread that they create unacceptable obstacles to accommodation of national or regional growth pressures, overriding action by higher levels of government seems almost sure to ensue. Long-range local opportunity to limit population growth thus appears limited.

By contrast, measures that seek to influence the character and location of growth, to minimize its interference with the quality of life, and thereby remove some of the basis for citizens' no-growth demands, hold considerable promise of effectiveness.

Social and environmental considerations can complement each other. With more conscious effort directed toward improved design, a more effective mix of land uses, and increased density within presently developed areas or appropriately sited new communities, the following benefits could be realized:

Savings in land. Reduced demand for conversion of forest or prime agricultural land for urban development.

Reduced cost per unit. Higher densities would promote savings in land, streets, curbs, sidewalks, and utility lines.

Better housing units. Interior spaciousness and individual privacy could be provided without involving excessive costs.

Reduced cost of services. If people were to live closer to one another, it would make it much easier for a locality to provide various public buildings and services as well as for residents to use them more intensively.

Savings in travel. The need for travel in daily life could be substantially reduced while expanding the opportunities for recreational travel. Many daily activities, including work, could be brought within walking distance of one's dwelling. The necessity to own a car or even two or three could lessen considerably.

Support for mass transit. Concentrated population per-

FIGURE 2.2-2 Natural Resources of the Long Island Sound Study Area

This map is a simplified version of the large colored map "Land Use and Critical Natural Resources" which appears in Volume 1: Summary

mits a more efficient use of mass transit.

Savings in energy. Integrated building systems could make possible energy savings in lighting, air conditioning, and heating. With reduced travel and more efficient utility systems, per capita energy requirements could be reduced without arbitrary restraints.

Current Land Use Planning

Since the boundaries of the study area were drawn to reflect drainage patterns rather than administrative divisions, they cut across many established local, regional (both interstate and substate), and state planning jurisdictions which are dealing with various aspects of these problems.

Local. The real power to affect land use decisions currently resides in the multitude of cities, towns, and villages, engaging in planning, zoning, and conservation activities. Most of the specific decisions affecting the location of residential, commercial, and industrial activities originate at this level.

Comprehensive plans of various planning agencies within the study area appear to recommend direct action, such as public facilities investment, more often than indirect controls and regulation. These plans recognize that building highways or buying parkland strongly influence growth patterns. The impact is felt indirectly, as well, by influencing private decisions to invest near or away from public facilities.

Localities often do take direct action, and should continue to do so as long as they can act effectively to satisfy local needs without unacceptable sacrifice of regional, state, or national needs. In some situations, however, problems are perceived only when large areas are considered. Solutions seem feasible, politically or technically, only at higher levels. Even more often, only higher levels of government have enough money to undertake needed actions.

Sub-state regional. Both Connecticut and New York are divided into substate regional planning areas. The regional planning agencies in the Connecticut section of the study area are Southwestern Connecticut, Greater Bridgeport, the Valley (Housatonic), South Central Connecticut, Connecticut River Estuary, and Southeastern Connecticut. The New York sector of the study includes the New York City Department of Planning, Nassau-Suffolk Regional Planning Board, Nassau, Suffolk, and Westchester County planning agencies. Except for Connecticut River Estuary, each has a land use plan for its area of jurisdiction.

State. New York State has two official plans. In 1971, the New York State Offices of Planning Coordination (now the Office of Planning Services) presented the first stage of the state's long range physical development plan. Published as *The New York State Development Plan-One*, it is designed to serve as a guide for state, regional, and local planning and development programs, as well as for developmental initiatives by the private sector. The plan proposed state goals and objectives for settlement pattern or population, land use, and transportation.

The *State Environmental Plan*, prepared by the Department of Environmental Conservation in 1973 is aimed at encouraging sound resource management. It deals with five major resource areas: land, water, air, fish and wildlife, and energy.

The *Plan of Conservation and Development for Connecticut* (1974), sets forth seven basic policies to conserve land and water resources. Like New York's plan, the state would assume a leadership role in land and water use policies to assure the appropriateness of development decisions. However, neither the New York nor the Connecticut plan construes this coordinating role as a substitute for planning at the local level.

A major objective of the Connecticut plan is to increase the density of development in such a way as to protect the natural environment and to decrease the cost of providing public services.

Regional. The Tri-State Regional Planning Commission is an interstate planning agency covering twenty-two counties in New York, New Jersey, and Connecticut. Its area of jurisdiction includes New York City, Westchester, Nassau, and Suffolk Counties in New York State, and four of the six planning regions in the Connecticut portion of the study area. The commission has prepared the *Regional Development Guide Plan*, as well as functional plans on outdoor recreation, transportation, and a regional plan for water, sewage, air, and refuse. The agency encourages coordination among all planning and transportation agencies within the Tri-State Region. The federal government has designated it as the official clearing house ("A-95") agency for federal level programs and projects to be carried out within its region.

The Interstate Sanitation Commission was created by compact between New York, New Jersey, and Connecticut for abatement of existing water pollution and the control of future water pollution in the tidal waters of the New York Metropolitan area. Air pollution has recently been added to its responsibilities. The commission's role in land use planning is indirect, through its emphasis on combined sewer and "non-point" sources of pollution, which will ultimately require coordinated water and land planning.

The New England River Basins Commission is a joint state-federal agency responsible for coordinating plans for use and development of water and related land resources. The commission is also directed to prepare and keep up to date a comprehensive, coordinated, joint plan for federal, state, interstate, local, and non-governmental development of water and related land resources. This Long Island Sound Plan is an authorized component of the overall plan.

Federal Legislation. Two important federal laws influencing land use are the U.S. Clean Air Act of 1970 and the Water Pollution Control Act of 1972. The U.S. Congress presently has under consideration several bills which would establish strong, new federal and state initiatives in land use planning throughout the United States. While no such land

use act exists at this writing, the Coastal Zone Management Act of 1972 is seen by many as an indicator of current national thinking on a land resource of special concern.

Both New York and Connecticut are responsible for preparing and maintaining implementation plans, in addition to permit procedures as required by the Clean Air Act. Although these plans largely focus on the use of available technology to limit existing pollution emissions, they also affect the location of some land uses. A provision for complex source requirements refers in particular to activities that generate substantial automobile traffic. Both states' plans also contain antidegradation requirements, whose full impact is not yet clear. The plans also serve to identify areas in both states that violate air quality standards and, by doing so, pinpoint places that cannot accommodate new sources of pollution.

Like the Clean Air Act, the Water Pollution Control Act is designed to promote a far more effective use of available waste control technology. Under the provisions of the amendments to the Act enacted by Congress in 1972, industrial firms must secure permits before they can discharge waste. To do so, firms must guarantee that they will apply the "best available technology" to clean up their wastes. More detailed discussion of this subject is to be found in Section 2.1 Water Management.

Objectives

The study has selected two overall objectives for the land use element:

1. Protect the available supply of special opportunity areas (water-related lands), particularly the shoreline.
2. Increase access to the amenities of the study area, particularly to the Sound itself.

To achieve these objectives in environmentally, economically, and socially acceptable ways, the following alternatives were considered.

Alternative Means of Protecting Special Opportunity Areas

The alternatives available to protect special opportunity areas, particularly the shoreline, fall into two groups: those which are primarily aimed at protecting the supply of these areas, and those which attempt to reduce the pressures to use those areas. The latter must be considered, since sustained development pressures can make it difficult to enforce protective regulations.

1. **Establish protective regulations.** The most straightforward way, short of acquisition, to protect special opportunity areas is to adopt and enforce regulations prohibiting inconsistent use. There is a growing precedent for regulatory action of this kind, at both state and local levels.

To prevent inappropriate development of special opportunity areas, state and local governments could establish regulations that make full use of constitutionally available powers. Such regulations, for example, presently apply to Connecticut's inland wetlands, but similar opportunities may also exist for prime agricultural lands and open space areas subject to development.

One objection to this approach is that it acts to drive up development costs either by reducing the available land supply or by forcing development into other areas that are less accessible or otherwise more expensive to develop. The seriousness of this objection is likely to hinge on the amount of land restricted relative to demand, the location of the restricted land, and its suitability for development in the absence of restrictions.

However, a more widespread objection to regulatory restrictions is legal, and focuses on the plight of the regulated landowner. If landowner losses incurred as a result of regulation are perceived to be small in relation to the public gain, regulations are more likely to achieve acceptance.

To the extent that local governments are willing and able to consider the well-being of residents other than their own, they should bear responsibility for land use guidance on matters of non-local significance. To the extent that governments are unwilling or unable to act in this manner, higher levels of government should assume the responsibility.

2. **Increase public awareness of benefits.** One way to increase acceptability of protective regulations is to sharpen public awareness of the benefits of regulations. Popular sensitivity to the biological importance of wetlands, for example, has generated protective restrictions that were unacceptable a decade ago. Awareness of hurricane dangers increases receptivity to restrictions affecting flood prone areas. Like the energy shortage, such forces create opportunities for action, which public officials should seize.

3. **Reduce the landowner's loss through cash compensation.** Still another way to strengthen acceptance of protective regulations is to reduce the financial loss to landowners. Direct cash compensation is one way, and reductions in the owner's tax payments is a variation.

Although compensation would overcome some objections to protective regulations, compensation measures are themselves subject to both economic and social objections. One set of objections is fundamentally administrative, and includes concern about the difficulties of distinguishing compensable from noncompensable regulations, fixing the amount of compensation, and assuring that the compensated landowner would be effectively prevented from obtaining later relaxation of the regulations.

There are also economic and administrative objections. Even limited application of compensation could be costly. Governments might retreat from the compensation principle, or relax restrictions to avoid paying compensation.

4. **Reduce the landowner's loss through use of the cluster principle.** Clustering, or planned unit development, can not only reduce the private loss attributable to protective regulations, but also serve a major public need,

by consuming less land.

Instead of requiring a landowner to spread development evenly over meadow and wetland alike, the cluster principle permits the grouping of dwelling units on the same number of lots that an equal number of single-family detached houses would require.

Clustering houses around common open space also reintroduces the design tradition of early New England towns. Greater housing variety can be provided on less land.

Through site review (submission of a site plan would be a condition for approval), a locality could be sure that site design conforms to environmental guidelines. The retention of open space permits a developer greater flexibility in site selection. It may be useful to consider giving the developer a bonus in increased density allowance if the site plan protects a key natural resource.

5. **Direct growth by public facilities planning and investment.** Major highways and highway improvements are key determinants of urban growth patterns, followed in importance by the location of trunk sewer lines and water mains. If development is to be guided effectively, an explicit plan should guide public investment, indicating both the desired location of new urbanization and the desired sequence of development.

Such a strategy would prohibit extension of sewer systems into environmentally critical areas where development should not occur – flood plains, major groundwater recharge areas, and places designated for open space or resource management uses.

Even with guidance of public investment, developed and developing areas encounter problems.

One problem is that services now being provided meet a highway, sewer or water need that has arisen from past and current development. Until all existing needs and problems are met, it will be difficult to use utility extension policies to shape development. A second problem involves coordination. Unless these government actions are supplemented by other policy measures, it is difficult to control the construction of private sanitary sewer systems in the urban-rural fringe. It is also difficult to coordinate highways and sanitary sewer location and timing.

If future development patterns in the Sound area are to enhance the quality of life, coordinated public investment will have to be more effective in transportation, community facilities programming, housing, renewal and redevelopment, industrial park location, and open space acquisition. And if public investments are to serve as an effective implementation device for guiding future land development patterns, it will be necessary to define a location and timing strategy in some detail.

6. **Use large lot zoning in selected areas.** This involves designating areas considered valuable for their natural resources, open space, or agricultural potential, and calls for very low-density (up to five acres) single family and agricultural use. This approach is for areas that are difficult to serve with public water and sewer, at least in the near future. In the absence of utilities, high density development of such areas would be environmentally damaging.

While large-lot zoning may be useful to protect fragile environments, it results in scattered development. It may also, though not necessarily, be a form of exclusionary zoning disguised as environmental protection.

7. **Use flood insurance programs to guide growth.** Federally subsidized flood insurance is available to eligible communities under the National Flood Insurance Program, administered by the U.S. Department of Housing and Urban Development. The Flood Disaster Act of 1973 has strengthened the program to require lending institutions receiving federal assistance to deny building loans to anyone in the flood plain not subscribing to the insurance program. Other financial pressures to encourage participation in the program have been added. See Section 2.10 Flood Damage Reduction.

8. **Reduce the private costs of "best use" through taxation.** One alternative for the states to consider is the establishment of effective economic incentives which permit and encourage the best use of special opportunity areas, including prime agricultural, recreational, and forest lands.

Environmentally sensitive taxation to control the timing and location of development could be tied to the establishment of agricultural and conservation zones. Agricultural zoning is used to encourage continuing use of lands best suited for agricultural production.

The pressures of suburbanization in urban fringe areas raises the price of agricultural land, one factor in making farming uneconomical. As a result, prime farmland is often sold to speculators or real estate developers. In keeping with a "best suitability" doctrine, agricultural zoning seeks to delay or prevent conversion to inappropriate urban use. But it should apply only to prime agriculture land. Agricultural soil suitability maps from the USDA Soil Conservation Service can provide the necessary data. A problem with this measure is resistance by landowners to zoning that would prevent sale of their land at urban market prices. Reduced tax assessments can reduce the economic consequences to the owner.

Another alternative to prevent development on lands unsuitable for urban use is to establish conservation zones to protect areas whose alteration would cause health problems or environmental deterioration. Such a protection policy depends on reinforcement by appropriate tax assessment and public investment policies. The conservation zone or natural resource district also attempts to assure adequate areas for future conservation, recreation, and certain agricultural pursuits. It can also include areas preserved as common open space in Planned Unit Developments as links in a larger open space system.

For areas highly sensitive to adverse impacts from development, a number of more specific conservation-oriented, zoning ordinances have recently been developed, such as flood plain, coastal plain, wetlands, stream bank, shoreland, and steep slope zoning. Often, any construction in environmentally sensitive areas requires a special permit.

This is true, too, for development with a high impact on surrounding development. Special use permits allow for a greater degree of detail and flexibility in controlling the quality of development and its impact.

One option to enable states to accumulate funds to buy needed land to provide economic incentives to farmers is for the states to establish capital gains taxes to recover a sizeable share of private profits originating in speculative real estate deals.

Several states require assessment of land at fair market value based on existing use (e.g., agriculture, conservation) rather than one potential value for urban uses. Government may also purchase development rights, or grant tax abatement or tax deferral for owners of agriculture-conservation land. This must be accompanied by a long-range commitment to keep conservation or agricultural lands beyond the reach of the speculative developer. There are laws, for example, that permit property owners to cede voluntary easements to the government, or place restrictive covenants on the land.

To date, tax abatement or deferral is a holding measure; it does not permanently protect, but does buy time.

9. **Requirements for environmental impact statements.** One approach to site control is to require an environmental impact analysis of proposed development. The environmental impact statement (EIS) does provide a channel for public officials to apply pressure on a developer to maintain environmental quality.

The EIS does not in itself stop or guide development. The EIS could do this, however, if incorporated as part of a regulatory measure. A development permit (e.g., subdivision, PUD) might not be issued, for example, *unless* the EIS assured minimal impact on the environment and public facilities, and conformed to an over-all plan (assuming one existed).

Because of the considerable administrative burden the processing of such statements would put on both developer and state agencies, statements should be a requirement only for projects whose size, location, and nature make them significant, or those that are not in accord with a state-approved development plan.

10. **Increase the density of urban development.** An option here would be to concentrate additional development, rather than let the same number of units spread indiscriminately over a large area. At the shoreline, development would be encouraged only in those areas already developed, and not in environmentally sensitive areas.

Direct assistance to large-scale, medium and high-density development could include, for example, more liberal financing and assistance to developers in assembling land for projects of 500 or more units. Such assistance could be contingent on design plans that meet criteria for a mix of housing types and rental levels. In addition, regulatory measures would replace low-density lot requirements with minimum density area requirements.

Direct support for and assistance to mass transportation, with high-density development at major transportation points or interchanges, should be a matter of the highest priority at all levels of government in the Long Island Sound region.

11. **Move non-water dependent development inland, while reserving needed shoreline sites.** Industrial sites along the shoreline, including land reserved for water-related industry, could be planned and used to obtain the greatest possible benefit from this scarce resource. These policies could be followed:

- Reserved land should be used only by industries that need shorefront sites so that they can ship by water.
- So that the needs of other industries may be satisfied without encroachment on the shorefront, an adequate supply of suitable sites having railroad and highway access could be reserved elsewhere. Some of these sites should be selected to satisfy the needs of power plants and other industries that need near-shore locations.
- Shorefront land should not be used for industrial storage if any alternative site is feasible.
- Site planning and use of shorefront industrial areas should accomodate non-industrial activities in the immediate area. Insofar as possible, commercial and industrial shoreline not used for shipping should be made available for public access and recreation as, for example, combining power plants and access to the shore.

12. **Acquire land through purchase: "Long Island Sound Heritage."** Fee simple acquisition is the most direct but also the costliest measure. Because of the high costs involved, a public land acquisition program should be used sparingly. In many cases, this may require acquisition plans based on advanced designation of appropriate locations for specific types of development or use.

One framework for open space acquisition involves the recognition of a potential system which could link the open space elements – or, more specifically, the water-related lands–shown in Figure 2.2-2 and in the more detailed Land Use and Critical Natural Resources Map in Volume 1: Summary. Future open space planning and acquisition could go forward, regardless of level of government, within this potentially linked open space system, and development would be consistent with it. Of particular importance in such a system could be certain key components situated along the littoral fringe of the Sound. These components should generally epitomize the geological, biological, and historic heritage of the Sound. They would also represent the most important immediate action opportunities within a coastal region's open space system.

13. **Direct regulation of the shoreline.** The shoreline of the Sound is the most critical land area within the study region. It influences the water and its quality. It is the locus of the most extreme pressures on the land itself. And it represents the sole means of access to the region's most precious resource, Long Island Sound.

Future growth of population and communities in the region will increase competition for use of the shoreline, and thus will increase the need to assure that each part of

this scarce resource makes the greatest contribution of which it is capable. Consequently, in addition to the measures above, comprehensive regulation of the shoreline and uses directly affecting it was considered.

The Study has concluded that there exist three general zones of decreasing importance to the Sound as one moves inland away from the shore: (1) the maritime edge, (2) the coastal sector, and (3) the interior uplands. It is the first of these zones which appears to be most in need of comprehensive regulation or management.

The maritime edge*– perhaps some 250 to 1000 feet wide, depending on topography, biology, and socio-economic factors – could be subject to a review procedure whereby development which would affect the use of the Sound by the general public would require a permit. Such a system would require some degree of participation by all affected levels of government.

Various combinations of institutional arrangements, ranging from direct state zoning to creation of regional review boards to delegating all management functions to local governments are considered and evaluated in some detail in Section Four: Carrying Out the Plan. Essentially, the study has concluded that, in view of the strong tradition of home rule, the states should consider delegating a key planning and management role to local, county, and other substate regional governments in the development and execution of the state coastal zone management plans.

Alternative Means of Increasing Access to the Region's Amenities

Access to the amenities of the LISS area, particularly to the waters and shores of the Sound, is severely restricted. Only seven percent of the beachfront around the Sound is open to all regardless of residence. Views of the Sound and of scenic land areas are limited because shoreline transportation networks and construction practices often deny visual access.

1. **Facilitate legal access.** Most often, residence restrictions preclude general public access to beach areas. While the area seaward of mean high water is in the public domain, use of the area above high tide by the general public is effectively cut off. Legal actions, such as those before the courts in both states, may obviate the need for other approaches, if the courts rule that the general public cannot be denied opportunity to use local, public beaches. In the event that such a decision is not forthcoming, there are a number of other options to improve general public access:

- Both states could reaffirm the ownership of the Sound and its shoreline below mean high water by the public, and declare it to be state policy that increased public access, over the long run, will be assured.
- Federal and state governments could condition future grants on the provision that local facilities be open to resident and non-resident alike, on an equal basis.
- The states or the federal government could also offer bonus grants or loans to those municipalities that voluntarily open presently restricted beaches at times when they are not being used to capacity.
- Governments could also obtain scenic or access easements from private property owners in return for reduced taxation on the owner's property. The types of problems associated with this technique were discussed above in connection with special agricultural or conservation districting. Its greatest potential applicability would be in protecting scenic vistas or areas by defining the type of development allowed, or in providing small footpaths to the shoreline or to particularly scenic points.
- A detailed survey of historical and present access to the Sound, such as public, mapped, and dedicated street ends at the shore, could be supported by each state as part of its coastal zone program.

2. **Improve physical access.** One method to improve physical access would be to provide suitable transportation services, not only additional parking facilities, but also improved public transportation. The potential for more mass transit service, minibuses, and ferry services, particularly the potential at times of peak demand in areas with low parking capacity within walking distance of the shore, was investigated.

Another method would be to require that all new development along the shoreline include the provision of pedestrian access to the Sound.

Outright public acquisition of access corridors or of development rights would insure the protection of scenic areas by limiting or restricting certain types of development which otherwise would block the view or the physical access to these areas. The purchase of rights-of-way through an owner's property for, say, use as a footpath or hiking trail, biking or riding path, would have the additional advantage of supplementing other means of physical access to the amenities of the region. As with direct acquisition of any kind, the main problem associated with these approaches is that of cost.

To complement the Heritage system of large, significant parcels, the states could begin to acquire small areas along the Sound for casual use, such as wading, walking, nature observation, and perhaps limited picnicking. Such areas would generally not provide for activities requiring supervision or elaborate capital investments. These sites could be scattered widely around the Sound, provide limited parking facilities, be maintained by the state, and shown on its recreational maps.

New streets could be designed to protect existing views of the Sound and open up new ones, and to encourage recreational driving and shorefront access.

*It should be noted that the definition of the maritime edge is only suggested here. A painstaking and detailed survey by the appropriate levels of government would eventually be needed.

Recommendations

Special opportunity areas: the shore

As part of their respective ongoing coastal zone planning efforts, both states should consider certain elements as important to any long range management program for Long Island Sound's shore. It should be noted that these are melded together in the study's proposal for a long term management program in Section Four: Carrying Out the Plan. They include:

1. Recognition of three general zones of varying significance in terms of land uses and activities on Long Island Sound: the *maritime edge* of direct or primary importance, the *coastal sector* of secondary importance, and the *interior uplands* of tertiary importance.
2. Protection of the maritime edge–perhaps some 250 to 1000 feet inland from mean high water, and offshore to the respective state boundaries, depending on topography, biology, and socio-economic factors–should be subject to an improved and coordinated process of planning and management.
3. Local involvement–municipalities acting individually and collectively, should have a key role in planning and managing the shore.

A general development plan should be prepared by those communities abutting the tidewater. Developments, even those outside the maritime edge, which would have a significant impact upon the waters or shoreline of the Sound should likewise be subject to stringent review and approval by appropriate non-local as well as local government.

4. Adoption of the following policies governing the use of all lands that would affect the shoreline or the waters of the Sound:

- Preserve the few natural and semi-natural areas left;
- Where additional development is permitted along the shorefront, the principle of concentration should be applied in order to maximize the amount of open space, points of access, and water views.
- New residential development adjacent to the shore should be designed to achieve medium to high densities thus reinforcing concentration while providing access to a larger number of people.
- Discourage and/or relocate non-water dependent development away from the shore. Encourage water-oriented commerce and recreation along the shore in those areas where development would not intrude on the natural setting.
- Encourage public transit to and away from shorefront facilities and locations to minimize present day, near-exclusive reliance on cars.
- New highways, interchanges and other road improvements should be carefully evaluated for their potential impact on the shore.
- Where not needed to correct existing water quality problems, large-scale sewering of shore areas (except in cities) should be prevented in order to avoid encouraging development.
- Design those streets which are near the Sound to increase public awareness and enjoyment of the Sound.

Other special opportunity areas

To protect the region's high-contribution natural areas, state and local governments should make full use of constitutionally available powers to identify, develop plans for, regulate, and/or acquire key areas of special opportunity. Examples of such areas are indicated in Figure 2.2-2 and in the more detailed Land Use and Critical Natural Resources Map in Volume 1: Summary and include: areas with potential for future water supply, prime agricultural and forest lands, stream belts, and inland wetlands (which are already regulated in Connecticut). Such actions include:

1. Local governments should encourage and, in some cases, require use of the cluster principle through appropriate ammendments to local zoning ordinances.
2. The states should establish effective economic incentives to permit and encourage the best use of special opportunity areas, by strengthening existing legislation for preferential assessment of prime agricultural, recreational, and forest lands.
3. All levels of government should acquire the fee title or development rights to those special opportunity areas whose best use cannot be realized in any other acceptable way. Such a program for prime agricultural land is presently underway in Suffolk County.
4. The federal Environmental Protection Agency should condition its sewer and wastewater treatment plant grants upon the development of local and regional (Areawide) plans which would direct development to environmentally suitable areas, such as existing urban centers.
5. The state legislatures should consider and, if appropriate, enact a law requiring impact statements to assure consideration of the environmental, economic, and social consequences of proposed development. Statements should be a requirement, however, only for projects whose size, location, and nature make them significant, or those that are not in accord with a state-approved development plan.
6. Federal, state, and local governments should intensify and extend current efforts to create public awareness of the need to protect special opportunity areas.

Access to amenities

The above recommendations provide for the regulation of land use and growth, so that the lands around the Sound and inland maintain, or gradually assume, a pattern of development most fitting to the environment and people's

use of it. This is not enough. People must be able to get to the Sound to enjoy it. There are three aspects of a socially responsible program to provide access to the amenities of the region: recognize the need for and identify the components of the region's open space systems; begin a long range program to acquire key components of this base; and provide legal access to the Sound, while respecting private property rights.

1. All levels of government should recognize the limitations and potential of the water related open space elements described earlier in the chapter and shown in Figure 2.2-2 and in the more detailed Land Use and Critical Natural Resources Map in Volume 1: Summary. They represent a framework for directing intensive development away from environmentally sensitive areas to more suitable locations. They also represent a potential open space *system.* Further open space planning and acquisition should go forward, regardless of the level of government, in the context of this potentially linked open space system, and development should be consistent with it.
2. The Study has concluded that there exists (1) a serious shortage of general public open lands along the shores of the Sound, (2) large concentrations of recreationally deprived low and moderate income families throughout and on the edges of the study area; (3) very limited state and local financial resources for providing significantly increased access to the Sound; and (4) a clear federal interest in the general health and use of the Sound, as evidenced by the massive federal expenditures on its restoration.

   Presently the federal role in recreation takes primarily two forms: 50 percent cost sharing in state or local acquisition and development of land through the Land and Water Conservation Fund or 100 percent federal control of recreation lands by the creation of national parks, national recreation areas, etc. Public comment on the recreation recommendations indicated that there is no support for a new national park or other federally-administered area. And although the Bureau of Outdoor Recreation, which administers the Land and Water Conservation Fund, believed that their existing program and other federal programs were sufficient to provide more recreation, a majority of the other study participants and the general public felt otherwise for the reasons listed above.

   The study therefore recommends that the United States Congress appropriate approximately $50 million to a "Long Island Sound Heritage Fund" which would provide up to 75 percent federal assistance for state and local acquisition and/or development of certain areas of particular recreation, conservation, and scenic opportunity. This key group, the Long Island Sound Heritage, epitomizes the geology, biology, and historical heritage of the Sound, and represents the most important immediate action opportunity within the open space system. Components are described in Section 2.3 Outdoor Recreation and Section 2.4 Sport Fishing and Wildlife, and are shown in Figure 2.3-2.
3. To complement the Heritage system of large, significant parcels, the states should begin to acquire small areas along the Sound for casual use, such as wading, walking, and nature observation. These sites should be scattered widely around the Sound, at an average of every five miles, should provide limited parking facilities, be maintained by the state, and indicated on recreational maps of the state.
4. Both state legislatures should reaffirm the ownership of the Sound and its shoreline below mean high water by the public, and declare it to be state policy that increased public access, over the long run, will be assured.
5. Each state should conduct a detailed survey of historical and present access to the Sound, such as public, mapped, and dedicated street ends at the shore.

Other recommendations affecting access can be found throughout this report, particularly in Section 2.3 Outdoor Recreation, Section 2.4 Sport Fishing & Wildlife, and Section 2.5 Shoreline Appearance and Design.

Outdoor Recreation

Background

To most residents of the Long Island Sound region, the Sound itself is usually thought of first and foremost as a vast and multifaceted recreation resource. People like to swim in it, boat on it, picnic near it, camp along its shores and estuaries, bicycle and hike around it, and drive near it. They may even derive pleasure just from knowing it's there.

This section deals with beach swimming, boating, and general recreation. Other recreation considered in the study but not discussed at length here include sport fishing and nature study (see Section 2.4 Sport Fisheries and Wildlife) and sightseeing and general aesthetic appreciation (see Section 2.5 Shoreline Appearance and Design).

All of these activities and many others take place in the region's existing supply of *open space* (see Section 2.2 Land Use and Growth.) The potential exists to physically, or at least conceptually, link together certain existing open lands and key additional acquisitions or easements to form an open space system (see Figure 2.2-2 and the more detailed Land Use and Critical Natural Resources Map in Volume 1: Summary). The existing open spaces which epitomize the geological, biological, or historic heritage of the Sound itself have been called a "Long Island Sound Heritage." Recommendations for both the recognition and management of this Heritage are found in Section 2.2 Land Use and Growth, and following in this section on recreation. These key parcels, situated along the littoral fringe of the Sound, form the keystone of the larger regional open space system.

Most of the attention of this water and related land resource study has focussed on the shoreline. The recommendations that relate to that shoreline would therefore work to strengthen the Heritage proposal. But there are other recommendations, for the larger open space system, which would help to divert some of the shoreline pressures inland. Discussion of these is found following under general recreation.

For each of the recreation activities discussed here, a methodology was developed to identify supply, quantify demand and, from these, derive the recreation needs for each of the nine subregions of the study area. The methodology employed was based upon that used for the North Atlantic Region Water Resources Study, adapted to this study area using the two states' comprehensive outdoor recreation plans and other available data. With this methodology, the total population of each subregion for the benchmark years of the study, 1990 and 2020, formed the statistical base for the development of the demand figures for the region. From the projected socio-economic composition of that population, assumptions were made regarding subregion residents' "propensity to consume" particular recreation activities as well as alternative opportunities (e.g., swimming pools, Long Island's south shore, and Rhode Island's beaches) for satisfying these recreation demands. In addition, extra-regional demands (e.g. of New York City, upstate New York, and Connecticut residents) upon the recreational resources of selected subregions were factored in. From these figures, the existing *supply* of recreation facilities was subtracted. The difference between the two was then called the need.

All of these figures were developed in terms of recreation activity user days. Applying commonly used spatial standards for different recreation activities (swimming, boating, camping, and picnicking), the need figures were converted into spatial demands on the resource base (e.g., miles of lifeguard protected beach, moorings and slips for boating). The resultant figures for each of the subregions in the study area for the years 1990 and 2020 are presented in Table 2.3-1.

This methodology produces projected figures which, although not precise, nevertheless provide an *indication* of the dimensions of future recreational need, and therefore the potential impact on the natural resource base. Many needs cannot be met.

Using these figures as an operating base, a primary planning objective was formulated: to improve the quality, quantity, distribution, and diversity of recreational opportunities for all people on or near the Sound.

What follows is a discussion of swimming, boating and general recreation in terms of existing conditions and future needs. Alternatives to meet the objective are explored and

TABLE 2.3-1 Future Regional Recreational Needs

	1990					2020				
Subregion	Miles of Shoreline Guarded Beach	Acres of Picnic Grounds	Acres of Camp-Grounds	Number of Boat Launch Ramp Lanes	Number of Slips and Moorings	Miles of Shoreline Guarded Beach	Acres of Picnic Grounds	Acres of Camp-Grounds	Number of Boat Launch Ramp Lanes	Number of Slips and Moorings
1	2.6	26	63	60	1,055	4.1	55	226	122	3,755
2	1.4	20	52	66	1,356	2.5	40	138	145	5,066
3	3.7	44	68	74	1,223	6.5	140	206	140	3,933
4	1.5	101	22	40	1,323	2.5	170	66	72	3,453
5	2.0	28	94	108	3,553	3.1	57	228	205	11,743
6	5.1	131	63	125	2,888	6.8	189	95	188	8,248
7	2.0	252	81	77	2,417	6.0	461	160	174	7,937
8 & 9	2.1	192	252	64	873	4.1	401	523	130	2,103
1–9	20.4	793	692	614	14,688	35.6	1,513	1,642	1,180	46,238

recommendations are made to meet the desires of the region's inhabitants.

Beach Swimming

Natural beaches account for approximately 262 miles of the total 600-mile coastline. About 200 of these 262 miles are privately owned, and about 43 miles are publicly owned but restricted in some way, usually to the residents of the municipalities in which a beach is located. Only 19 miles–7 percent of all Sound beaches–are open to anyone from anywhere. There can be little doubt that if more public beaches were available to the general public, they would be used. In fact, it is estimated that 25 miles of public beachfront–5 miles more than presently exists–are needed right now. By 1990, about 20 additional miles will be needed, with another 15 miles by 2020.

Numbers are not the entire story, however. While beaches are used by more people during the summer season than any of the other recreational facilities on the Sound, that season is extremely short. The peak use of beaches occurs between mid-June and mid-September, and the total number of peak use days ranges from ten to thirty. Very few of the region's public beaches have recreational facilities other than those relating directly to swimming. As a result, beach areas are overrun on a few days of the year and are, in effect, an underutilized recreational resource for most of the rest of the year. It should be noted, however, that these beaches do offer a pleasant environment for surfcasting, kite flying, dog exercising, or just walking during the off-season.

Except for a few inaccessible areas on the eastern end of Long Island, almost all good quality *natural* beaches around the Sound are being utilized, to some extent, for swimming, sun bathing, and related activities. The potential for most exclusively local beaches to meet regional needs is limited, since most are already fully utilized during peak times. In addition, these beaches typically do not have enough width or length, good quality sand, adequate access, parking area, or other backup space that would be necessary to serve larger numbers of people than now use these areas.

In addition to the natural limits on the resource potential, there are numerous social and legal restrictions limiting access to the Sound's beaches (see Figure 2.3-1).

From an access and ownership point of view, there are three distinct types of beaches around the Sound. Class A Beaches are major facilities owned and maintained by the state. They do not restrict access at all, although a minimal parking fee may be charged to cover some portion of the facility's operating expenses. Examples include Hammonasset and Sherwood Island State Parks in Connecticut, and Sunken Meadow and Wildwood State Parks on Long Island.

Class B beaches are owned and maintained by municipalities and counties. They may or may not be restricted to local residents. If they are restricted, however, only a modest non-resident fee which bears some direct relationship to park operating expenses is charged. Unfortunately, the numbers of this class of beach are limited. Examples include Lighthouse Point Park in New Haven and Tappen Beach in North Hempstead. Both charge a two dollar non-resident parking fee. Examples of those available at no charge to non-residents include Ocean Beach in New London, Pleasure Beach in Bridgeport, and Orchard Beach in the Bronx.

Class C includes the balance of beaches along the Sound. They are highly restricted on the basis of residency, membership in a club, or simply by individual ownership. With few exceptions, these beaches do not have significant regional potential for recreational use without extensive modification.

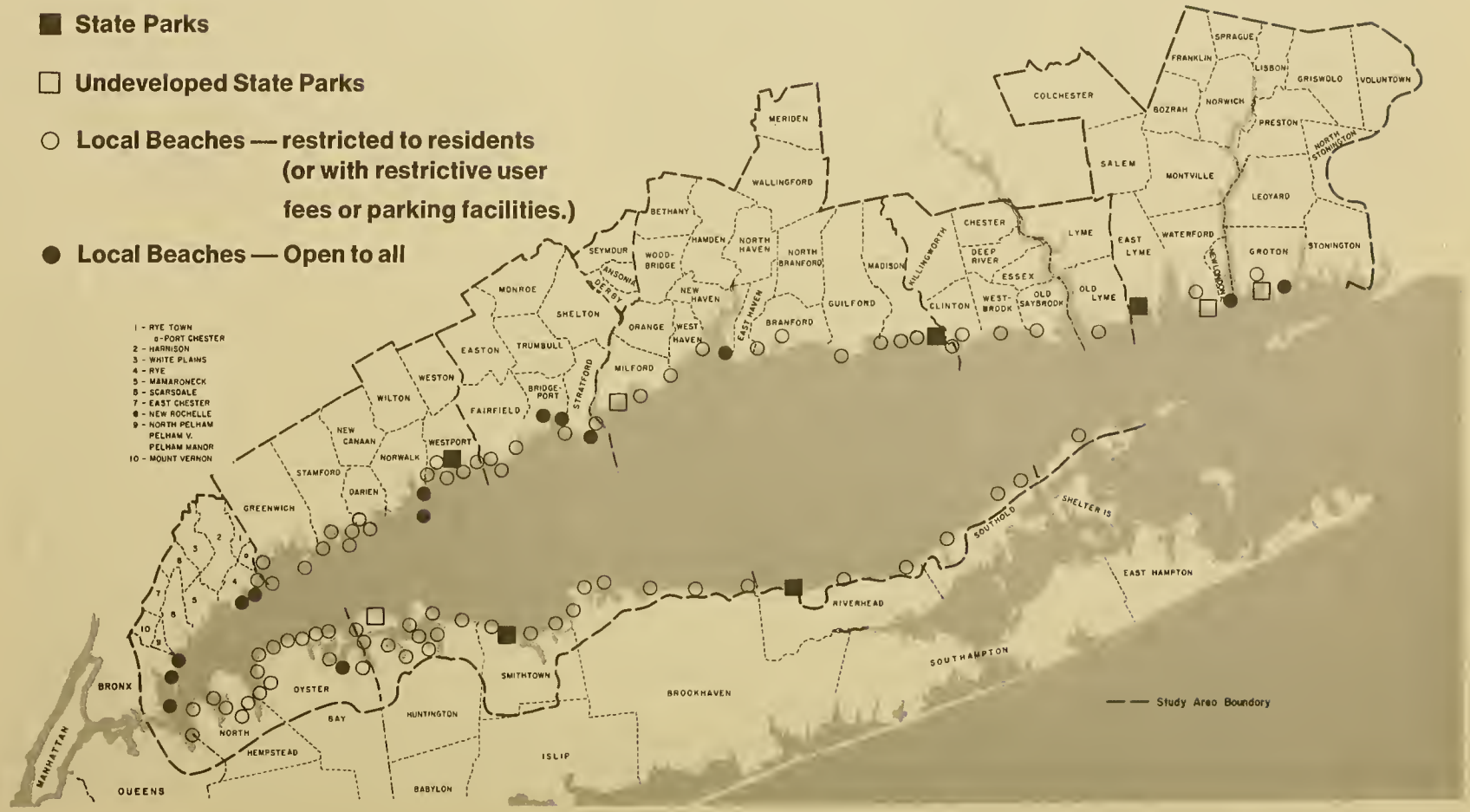
While access to many Class B and C beaches is restricted, there are numerous instances where beaches in all three classes have received public assistance, either directly or indirectly through state and federal aid programs. These include beach nourishment programs, where the Corps of Engineers and/or appropriate state agencies contract to have sand fill placed on or seaward of existing beaches; federal open space and recreational land acquisition and development programs; state and federal road building programs which provide access to many of the region's beaches; and water quality improvement programs which will improve the quality of existing beaches, and are being paid for by the public at large through massive federal, state, and local financing. In fact, the issue of non-local aid to town beaches is central to several court challenges to localities in both New York and Connecticut.

Alternatives

In line with the planning objective of improving the quality and expanding the quantity, distribution, and diversity of recreational swimming opportunities, a number of alternatives were considered, including:

1) *Improved efficiency* In view of the economies achieved by making more efficient use of already owned public facilities, a number of such opportunities were identified before considering the expenditure of additional public funds for entirely new acquisition and development. These include improving selected public beaches by expanding parking, restaurant, rest room, and other support facilities, and the addition of off-season facilities; providing additional staff, including lifeguards, maintenance crew, and park police, thus increasing the amount of time a beach could be utilized; nourishing beaches with sand to expand their capacity (and have the added benefit of providing erosion and storm damage control); and altering the work week so that Saturday and Sunday would no longer be the period of peak recreational facility usage. This last change, while extremely difficult to implement because of the social obstacles it would encounter, would provide the least costly method of expanding regional recreation opportuni-

FIGURE 2.3-1 Public Beaches on Long Island Sound



ties.

Evaluation of these specific measures took place on a case-by-case basis. None was recommended where its implementation would result in overutilization or overcrowding of existing facilities.

2) *Improved Access.* Another relatively inexpensive way to optimize the use of presently underutilized beaches is to improve both legal and public access.

For the most part, the issue of expanding legal access to the Sound's waters, through publicly or privately owned land which is presently restricted, is a matter that ultimately will have to be resolved in the courts. The study identified incentives for voluntary opening of beaches by those localities fortunate enough to have beaches with unutilized potential. These include conditioning approval of all state and federal grants for beach acquisition, development, or improvement upon making the beach and adequate parking available to non-residents; and charging a small daily fee for non-residents on a sliding scale so that the fee is less during off-peak hours or days. This fee would help to defray additional maintenance costs.

Means of expanding physical access to certain existing and proposed beaches include the development of new or improved roads, foot or bike paths, improved mass transit facilities, including adequate provision of bus parking areas at State Parks, and recreational, passenger-only ferry service, particularly to beaches lacking good road access, such as those on islands or narrow spits of land.

This last alternative, recreational ferry service, is not a new concept. Passenger recreational ferries have successfully operated for more than half a century in many European countries. In the United States, similar ferries are presently operated in San Francisco, Los Angeles, Martha's Vineyard, and Greenwich, Connecticut, to name just a few. Service between Greenwich and Little Captain Island has operated for more than twenty-five years. The annual cost of operating this ferry service, which is capable of carrying more than 1000 passengers per hour, has been less than $100,000 in recent years. This figure includes amortization of capital equipment (two ferries), and all costs. It compares favorably to annual cost of building and maintaining roads, and parking areas. Moreover, ferries offer an attractive way of controlling the number of people at a particular facility. Once the capacity is reached, ferry service to the facility is suspended or diverted to another facility.

3) *Public Acquisition and Development.* While the most straight forward of the several alternatives considered, public acquisition and development is also the most expensive. In spite of this expense, the demand for beach swimming is so significant, particularly in light of the available supply, that a number of shoreline areas were examined for their potential as State Parks or Class A Beaches. Several opportunities for Class B Beaches also were identified.

4) *Alternatives to the Shoreline.* Since the shoreline of the Sound is finite, and its value so high, several alternatives to saltwater swimming were considered, to accommodate at least a portion of demand and deflect some of it away from the shoreline. Specific options considered included acquisition and/or development of existing inland lakes; installation of shoreside swimming pools in areas where there is some physical constraint to swimming in the Sound, such as in areas of poor water quality, or where the shorefront itself is too limited to support additional use; and acquisition and/or development of offshore islands. The possibility of developing entirely new, artificial islands and peninsulas for recreational purposes was also explored in a special study, and found to be attractive, both in terms of costs, relative to acquiring shore frontage, and uniqueness of the experience.

5) *Redevelopment.* In an area as highly developed as the region's shoreline, conversion of existing land uses offers a more significant opportunity for satisfying regional recreational needs than acquisition and development of the scarce vacant land along the shore.

In recent years, redevelopment has come to be associated with a specific federal program, urban renewal. While this program or its successor, the Community Development Act of 1974, may be useful in certain circumstances, there are other examples of land redevelopment which can offer opportunities for providing more public beaches. Among these options are private conversion of developed land to altogether new developments, where setbacks, access provisions, and easements to the water might be secured from the developer; and conversion of land subject to devastation by erosion and flooding. Flood-prone land offers the most significant potential, particularly after a flood or major storm which leaves structures in the flood plain damaged beyond repair. The Flood Disaster Protection Act of 1973 will provide significant opportunities for this type of redevelopment over the long term. For further detail on this subject, see Section 2.10 Flood Damage Reduction.

Boating

Among the finest and most protected bodies of water in the United States for recreational boating, Long Island Sound harbors one of the largest fleets of recreational boats in the world—an estimated 125,000 craft of all sizes and types. About 50,000 of these boats are permanently berthed during the summer in the waters of the Sound or its estuaries. Another 50,000 boats are trailered to the Sound, and about 25,000 smaller boats are stored along the beaches, cartopped, or stored aboard other, larger boats.

Unlike other elements of the study, the need for boating has traditionally been met by the private sector of the region. Boats are bought, maintained, stored, and chartered by the private individuals and companies who either make their living or in some way participate in the quarter billion dollar boating industry of Long Island Sound. Direct governmental, or public involvement in recreational boating along the Sound has been pretty much confined to the

provision of boat ramps and parking spaces and occasionally slips and moorings at municipal facilities. Indirect public involvement, on the other hand, is often more extensive. Certification of junior boaters, regulation and enforcement of safety practices and mooring areas, provision of navigational aides and channels, and state or local land use regulation, such as zoning and wetlands regulations, are all among those activities that different levels of government are responsible for.

Boat ownership is an activity which is closely linked to family income. The median value of a craft berthed on the Sound is about $2,500. Annual maintenance and storage expenses average more than 10 percent of this. Even boat rentals or charters have significantly increased in costs and decreased in availability as marina and charter operation expenses—taxes, insurance, labor and land—have soared with the cost of living.

It is ironic, therefore, that while boating represents one of the most expensive recreation activities, it is remarkably underutilized. On any given day, less than 25 percent of the recreational boating fleet is out. Thousands of slips and moorings are occupied by craft which are being utilized only a very few days per year. In spite of this, the estimated demand for berthing facilities exceeds supply by 10 percent right now. Projected increases indicate that demand will outstrip supply by about 30,000 more boats by 1990, and 76,000 more by 2020. Co-ownership of boats and improved boat rental opportunities would both help to increase the existing supply by more efficient use of the existing fleet.

While the Sound itself can probably accommodate this increase in the number of boats, the impact on the shoreline where these boats will have to be stored or launched will be significant. Presently, an estimated seventy miles of shoreline is devoted to boating facilities—predominantly marinas, but also including scattered launching ramps, docks, and slips. An additional area of shoreline equal to at least one half this present amount of shoreline would be needed if we were to meet future boating demand in the same manner we have in the past. While this may not seem like an overwhelming amount of land to devote to this activity, the problems become immediately apparent when you look for potential locations for boating facilities.

Historically, marinas have often been located in wetland areas. However, with the regulations recently passed by both states, new boating operations in wetlands will be prohibited and thus locations for boating facilities will be severely limited. Possibilities for expanding facilities in harbors presently used by recreational boats are limited, as these harbors are already congested, particularly on weekends, due to the volume on peak use days, narrow channels, and the often haphazard profusion of moored boats.

Central to meeting future needs, then, are such fundamental issues as who should have access to boating on the Sound, the role of the private and public sectors in providing future boats and related facilities, the number and kind of boats which can be accommodated in the Sound, and whether to regulate the boaters or the burgeoning number of boats plying the Sound's waters.

Alternatives

A number of alternatives were explored which would enable the various levels of government to be responsive to this anticipated increase in demand while still recognizing the constraints upon the existing supply.

1. *Private Acquisition and/or Development.* The private sector presently provides the vast majority of services to boaters of Long Island Sound. No fundamental change in this role is foreseen nor is it recommended. While it would be inappropriate for this study to recommend specific private development, it has identified a number of opportunities, including harbors, coves, and embayments with underutilized recreation boating potential and areas where dry slip facilities or large boat storage warehouses might be developed. These units are typically not land or water consumptive although their scale may limit them to certain relatively urbanized harbors. The study has identified opportunities on a harbor-by-harbor basis in each subregional section.

2. *Public Acquisition and/or Development.* The study anticipates an increasing role for the public sector, not so much to compete with the private market, but to complement it with services the private market has inadequate incentive to provide. Specific public activities considered include development of additional boat launch lanes and backup parking facilities, and municipal and county development of public marinas at key harbors around the Sound. Such facilities should be developed to nationally established standards, including ramping to below low tide line, adequate parking for cars and trailers, multiple ramps, and floating docks. These might also provide transient boating facilities, boat rental and instructional programs, shuttle service to mooring, access via public transportation and, where appropriate, ferry service to nearby parks and beaches.

3. *Governmental Regulation.* Because the number of boats along the Sound continues to grow, and with it the safety risks, a number of options for governmental regulation were examined, including annual licensing of boat operators, one-time certification of competency, no governmental involvement in pleasure boat operation at all, state permit procedures for both dry and wet marina development and operation, bi-state or federal zoning of the waters of the Sound itself to separate commercial navigation from pleasure boating and to limit power boating near beach swimming areas.

4. *Redevelopment.* Conversion of shore land uses by natural forces, private development, or public acquisition provides a significant opportunity for developing additional boating facilities. In relatively urbanized areas, this conversion might take place as oil tanks and non-water related industry are relocated inland.

Redevelopment, particularly in well protected harbors

and embayments, should be evaluated in the broader context of the region's needs for additional boating facilities. New marinas and mooring areas could help to meet the region's growing demand for boating, provide tax revenue, and stimulate attractive, water-enhanced development.

In less densely developed areas, a number of opportunities for launching ramps and auxillary parking facilities have been identified at potential redevelopment sites.

5. *Multiple Use.* Some existing and future public utility property located on the shoreline could be used for boating access, especially for small boat activity. The trend set by Long Island Lighting Company and Northeast Utilities to provide boat launch ramps and other recreation facilities at their nuclear power plant sites on the Sound might be continued for all future public utility developments on the shorefront.

6. *Alternatives to the shoreline.* Some satisfaction of future needs may be attained by providing facilities away from the shoreline. Specific options include boat rentals, launch ramps, and limited slip development on inland lakes; and mooring boats in the Sound at some distance from the shore and serviced by launches.

General Recreation

To most of the residents of the Long Island Sound region, recreation means more than just swimming and boating. It also means camping and hiking, picnicking and bird-watching, ball-playing and tennis, and nature conservation and education, to suggest just a few.

While most of these activities do not require a shoreline location, all are enhanced to some extent by the proximity of water. Also, many of the recreational activities, such as picnicking, swimming, and ball playing, are further enhanced by their proximity to one another, allowing one to enjoy several different recreation forms in one area. This is why multi-purpose parks are so popular for day outings, particularly among families.

An abundant supply of open space exists throughout the region. For the most part, this open space is not concentrated along, or even connected to, the shoreline area, where the pressures for public access are greatest. Where there are recreation areas along the shore, they are mostly small sites sandwiched in among larger residential areas. Moreover, these facilities often do not take full advantage of being near the Sound by providing the full compliment of recreational activities.

Camping and picnicking, for example, are two of the most popular and relatively inexpensive recreation activities. Future demand is expected to be even larger. An additional 800 acres of picnic grounds will be required by 1990 and another 700 acres by 2020 to meet the region's anticipated needs. By 1990, it is expected that an additional 700 acres will be needed for camping and some 1600 acres by 2020. While much of these needs may have to be met inland away from the water's edge, and in large measure by the private sector, some opportunity does exist for such facilities to be incorporated into existing or proposed state and regional parks along the water's edge. To the extent they can be met along the Sound's shoreline, they would form an integral part of the Long Island Sound Heritage (see Figure 2.3-2). Where they are located inland, they would strengthen the broader open space system.

Alternatives

1. *Public Regulation.* Much of the existing open space is presently subject to regulation by the states. Watershed lands, flood plains, and wetlands are examples. Each could meet some of the region's anticipated demands for future general recreation if efficiently utilized. Recreational easements–wetland boardwalks, camping areas, walking and bike paths–could be secured by the appropriate regulating agency. Enabling legislation could be passed which would allow state or local agencies the right of first refusal on potential components of the larger open space system, such as country clubs, estates, and tennis courts.

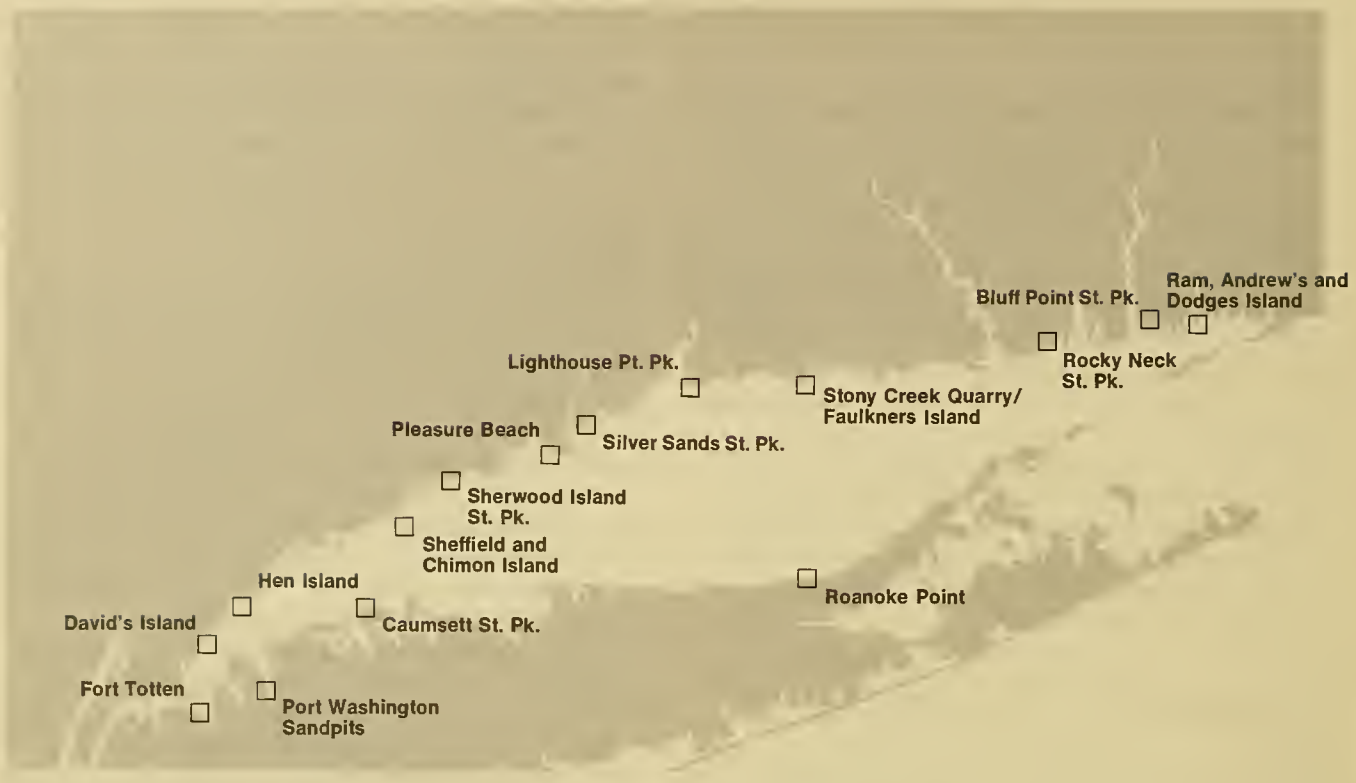
2. *Public Development.* A significant proportion of the region's estimated needs for general recreation could be satisfied by some further development on lands already in public ownership. Additional picnicking and camping sites, playfields, and linkages, such as walking paths and bike paths are examples.

3. *Public Acquisition.* While zoning affords some measure of protection to those relatively undisturbed areas of significant scenic, ecological, or recreational importance, either along the shore or inland, outright public acquisition and management of these areas may be necessary for maximum protection and public benefit. It is also the most expensive alternative, and was therefore considered only after other means of securing adequate open space were demonstrated to be inadequate. Particular attention was paid to opportunities for future local action. Figure 2.2-2 and the more detailed Land Use and Critical Natural Resources Map in Volume 1: Summary indicate those general corridors where future acquisition could work to link general recreation areas together.

4. *Access Improvements.* Wherever possible, the study examined means of improving access to or within the existing and proposed open space system. Specific options included development of physical linkages between existing and proposed general recreation facilities, such as bike paths and walking trails, and improved and coordinated mass transportation scheduling.

5. *Education and Programming.* One of the most efficient and least costly means of optimizing use of existing and proposed general recreation facilities is the public provision and encouragement of recreational programs. Such programs not only insure efficient use of existing facilities, but also serve as a means of introducing newcomers to a particular recreation activity.

FIGURE 2.3-2 Long Island Sound Heritage Proposals



Evaluation of Alternative Plans

Three alternative plans were considered for meeting the region's needs for swimming, boating, picnicking, and camping, each one utilizing one or more of the measures described above.

One plan, emphasizing environmental quality, would rely heavily upon the satisfaction of regional recreational needs by providing additional facilities which did not require significant structural development. In other words, only natural beaches would be acquired and developed as new beaches, with access to these and other existing parks provided by mass transportation, biking, and pedestrian ways. No new roads or parking lots would accompany the parks of the future. Boating needs would probably not be met at all, and the environmental quality plan might ban all power boats from using the waters of the Sound, except possibly public small-boat rentals.

This plan would probably meet most of the region's needs for future campgrounds and picnic areas, although it might not support the alternative of allowing this kind of recreation development on public utility-owned land, particularly watershed lands. Most, if not all, of the campers needs would be provided by destination or primitive campgrounds, and very little transient (private and motel-like) campground development would occur.

A second plan, stressing economic efficiency, would likewise meet the region's needs for recreation. Various studies conducted by all levels of government throughout the United States seem to support the position that recreation activity has a real and measurable economic value to the participants. This value varies among participants according to the amount of disposable personal income available for recreation and the accessibility of the recreation activity. Family income in the Long Island Sound study area is higher than the national average, but so are living costs, including recreation expenditures. The study area has large inner-city pockets of poverty with a low incidence of automobile ownership. Both the rich and poor suffer from limited public access to the water. For these reasons, beach swimming may be worth $5 per day to the person who participates in that activity; boating may have a value of $5 and upwards per day to the individual who chooses to pursue that activity.

Keeping this in mind, then, the economic efficiency plan would provide cost-efficient recreation projects, where the benefits exceeded the costs by some significant margin. But this plan would also advocate efficiency and therefore greater density for all of the recreation activities considered. State parks would be developed with massive parking lots and many concessions. This plan might very well subordinate the natural quality of the experience to the quantity that could be provided at a particular location.

The economic efficiency plan would most certainly advocate the provision of slips and moorings for the Sound's anticipated boating needs for the future. Not only

would the value of the experience itself justify this kind of public commitment, but so too would the multiplier effect of boating upon the region's economy.

Recommended plan

A third, and recommended plan, is based on the study's conclusion that a framework for meeting the region's recreation needs must be developed to increase the quantity, quality, diversity, and distribution of recreation facilities.

This discussion of alternatives has focussed on five general approaches: more efficient use of existing facilities, better access to existing facilities, exploitation of opportunities for shared recreation activities at non-recreation facilities, public acquisition of land with recreation potential, and opportunities for private development or provision of selected recreation facilities. Within each of these five general approaches, a variety of specific measures were proposed depending upon the subregional need and capability for the given recreation activity. These five approaches and some of the selected measures are reflected in the recommendations below. To optimize the quality, diversity, and distribution of recreation opportunity, the study team has identified a number of policy recommendations which are also listed below.

Recommendations

1. *Long Island Sound Heritage.* The study has concluded that a serious shortage of general public open lands along the shores of the Sound exists. Large concentrations of recreationally deprived low and moderate income families live throughout the region. State and local financial resources for providing significantly increased access to the Sound are very limited. A clear federal interest exists in the general health and use of the Sound, as evidenced by the massive federal expenditures committed to its restoration.

The study therefore recommends that the United States Congress appropriate approximately $50 million for a Long Island Sound Heritage Fund to provide up to 75 percent federal assistance for state and local acquisition and/or development of certain areas of particular recreation, conservation, and scenic opportunity. Presently the federal role in recreation takes primarily two forms: 50 percent cost sharing in state or local acquisition and development of land through the Land and Water Conservation Fund or 100 percent of federal control of recreation lands by the creation of national parks, national recreation areas, etc. Public comment on the recreation recommendations indicated that there is no support for a new national park or other federally-administered area. And although the Bureau of Outdoor Recreation, which administers the Land and Water Conservation Fund, believed that their existing program and other federal programs were sufficient to provide more recreation, a majority of the other study participants and the general public felt otherwise for the reasons listed above. Hence, the study recommends a "Long Island Sound Heritage Fund." In the event that this funding is not forthcoming, both states should consider these as areas of most immediate priority.

Following are a number of prime recreation candidates. Much more detailed site plans, including minimizing impacts upon wetlands and other natural systems, detailed cost estimates, and capacity ratings will be required for each.

For Connecticut:

- *Bluff Point State Park* should be developed by the state by 1977. The southeastern portion could serve as a swimming beach in conjunction with Ram Island (see below). The western and interior portions, which are more fragile could be a casual recreation resource, for picnicking, nature walks and wildlife areas. The eroding sandy strip to the west should be retained in its undeveloped state and its use carefully managed. Development on the southeastern shore might include about one-half mile of beach, while development inland should include an interpretive nature center, walking trails, and about 500 picnic sites.
- *Ram Island* in the Mystic Island group should be acquired by the state by 1980. *Dodges* and *Andrews Island* are also recommended for wildlife refuges (see Section 2.4 Sport Fisheries and Wildlife). A ferry service from Bluff Point State Park would serve Ram Island. Development here could provide at least one-half mile of beach.
- *Rocky Neck State Park* in East Lyme should be expanded by the annexation of undeveloped portions of the soon-to-be abandoned Niantic State Farm for Women. This 850-acre tract includes prime natural areas, Bride Lake, and a significant fresh-water marsh. Buildings on the site should be put to some appropriate re-use, while development of the open land should take place by 1985 and could include about 400 campsites. Construction of an erosion control structure at the mouth of Bride Brook should result in the natural restoration of about 0.6 miles of beach.
- *Hatchett Point* in Old Lyme should be acquired by 1990 for development as a major new shorefront park. Development of this 300-acre site could include about 500 picnic sites and about one mile of beach. Access to the facility might be provided by the development of a small spur from Penn-Central's Shore Line, which runs along the northern boundary of the site.
- *Stony Creek Quarry/Faulkner's Island.* Both parcels should be acquired by 1980 to serve as a single interrelated casual recreation resource. A small recreational ferry or launch would provide access to the historic island after the Coast Guard automates the lighthouse there. Development of both units could provide 300 picnic sites and at least one-half mile of beach. This park has important varieties of Sound

topography, running from interior wooded uplands right down to the sea.

- *Lighthouse Point Park* should be upgraded and expanded to the east by 1985, through the acquisition of flood-prone lands along Shell Beach on an "as available" basis. The entire complex could be designated as a state park and developed with about one-half mile of beach, 500 picnic sites, and provisions for a ferry service to downtown New Haven. The purchase and restoration of portions of the Morris Creek wetlands and the development of a beach/wetlands boardwalk and foot bridge would provide an excellent field lab for a Classroom by the Sound here.
- *Silver Sands State Park* should be developed immediately by the state and expanded by 1980. Additional acquisition should include the flood prone area of Fort Trumbull Beach (about 0.3 miles) and Charles Island, which should be significantly enlarged and nourished with sandfill. A boardwalk should be developed from the expanded and developed Silver Sands State Park to Charles Island to serve as both a fishing pier and for access to the Island. Development plans on the island and at the shoreside park could include 500 picnic sites, about two miles of beach, including the sand nourished shore of the island, and a small public marina facility including boat rentals and slips.
- *Pleasure Beach in Bridgeport.* To protect this unique complex and to provide a major state facility proximate to the source of the demand, property title should be transferred to the state by 1978 and the facility substantially upgraded for development as a state park. In addition, Long Beach in Stratford should be included in this new park as the existing leases on the land expire. Additional acquisition in this area could include the Great Meadow wetlands complex for use in conjunction with a Classroom by the Sound nature center. Ferry service should be developed between downtown Bridgeport and the existing ferry dock at Pleasure Beach. Additional access would be provided by the retention and restoration of the existing bridge to Pleasure Beach from Bridgeport and by development of a new access road to Long Beach from Great Meadows Road in Stratford. Parking should be located at or near the northern end of the bridge, with shuttle bus and pedestrian access from there. Recreational use of portions of Long Beach will have to be restricted during the Least Tern nesting season.
- *Sheffield Island* in the Norwalk Islands group should be acquired by 1975 for development as a public offshore swimming and general recreation facility. *Chimons Island* is also recommended for inclusion in the Heritage as a wildlife refuge (see Section 2.4, Sport Fishers and Wildlife). Access to Sheffield Island could be provided by a public recreational ferry service between Norwalk and the island.
- *Sherwood Island State Park* should be expanded by 1980, to include the flood-prone properties immediately to the west (0.4 mile) and additional lands between the northern park boundaries and the Connecticut Turnpike. Additional development would include 500 picnic sites and four boat ramps.
- *Beach nourishment.* The U.S. Army Corps of Engineers should artificially nourish each of these beaches, where feasible and appropriate, to provide an average beach width of about 300 feet.

In New York, the State Office of Parks and Recreations should capitalize on the following opportunities:

- *David's Island in New Rochelle* should be acquired for development as a small park by 1978. Included in its development would be about 0.8 miles of lifeguard protected beach, 200 picnic sites, and twenty-five to fifty transient marina slips. Access would be provided by ferry service from New Rochelle.
- *Hen Island in Rye* should be purchased as a wildlife management and nature observation area which could operate in conjunction with the existing marshlands conservancy. Development might include a Classroom by the Sound.
- *Fort Totten in Queens* should be developed as a major, multi-purpose recreation facility by 1980. Development here could be modeled after Mission Bay in San Diego or Toronto's new waterfront park. It should include preservation and rehabilitation of the architecturally and historically significant buildings within the fort, sand nourishment of the beaches to both the west and south of Fort Totten (about three miles), 100 picnic sites, a major public marina facility including public boat rentals, launch ramps, and slips and moorings, a parking garage and a pier for recreational ferry service to Caumsett State Park.
- *Port Washington Sandpits* should be acquired and reclaimed as a major new public shorefront facility by 1980. While certain compatible non-recreational uses might be permitted along the western boundary and the interior, the emphasis of the reclamation, particularly near the shore, ought to be the provision of expanded recreational opportunity. The existing town and county parks could either continue to operate within the new park or as part of it. Detailed plans should be developed in concert with the Town of North Hempstead and Nassau County.
- *Caumsett State Park* should be developed by the state by 1980 to serve as a regional Long Island Sound beach and as a casual recreation facility inland. This park, particularly the Fly Island wetlands complex, would provide an ideal location for a Classroom by the Sound. The shore of Caumsett would provide more than one mile of lifeguard-protected swimming beach. Development of the inland portion of the total park area should be limited, but include the preservation and appropriate reuse of the buildings, about 200 camping sites, and an equal number of picnic

sites. Access to the expanded Caumsett State Park would be provided by only minor improvements to the existing road system, the development of a small mini-bus service from inland parking facilities, and by passenger recreational ferry service from Fort Totten and Oyster Bay (near the railroad station) to the existing dock within the cove.

- *Roanoke Point in Suffolk.* Approximately 450 acres of beach, bluff, and woodlands along Suffolk County's North Shore between Roanoke Landing and Jacobs Point should be acquired as a public recreation and scenic preservation area. A portion of the area, to the back of the bluffs, could be used for camping, hiking, picnicking, and related recreation activities. Access to the beach or to the bluffs themselves, which are extremely fragile and eroding at a disturbing rate, would be limited to only two or three pedestrian access points in order to provide conservation protection.
- *Beach nourishment.* The U.S. Army Corps of Engineers should nourish these beaches, where feasible and appropriate, to an average width of about 300 feet.

2. *Artificial islands.* New York should actively cooperate with the U.S. Army Corps of Engineers in their ongoing research into artificial islands. Should these prove feasible and environmentally acceptable, New York and the Corps should undertake construction of at least one such island—perhaps an Orchard Beach Island close to New York City, to meet swimming, boating, and fishing needs of urban populations by the year 2000. Construction waste from New York City and selected harbor dredged materials should be used as fill. Connecticut should find appropriate locations for similar islands and establish timetables for construction and use.

3. *Recreation and conservation bond funds.* Connecticut should give serious consideration to the development of a $25 million recreation and conservation bond fund similar to New York's Environmental Bond Act of 1972. New York should either reserve a portion of its own bonded fund or set aside general appropriations for use on the Sound. Money from both states' environmental bond funds would assist in the full development of the Long Island Sound Heritage proposal. In addition, these bond funds, together with federal Land and Water Conservation Fund money, would provide a significant tool for the acquisition and development of other conservation and recreation proposals throughout this report, particularly lands upon which rights of first refusal had been secured or those devastated by flooding.

4. *Local beach policies.* State and federal agencies which administer financial aid programs to local and county governments for park improvements should reaffirm and strengthen existing regulations regarding general public access. Funds from these agencies for development, maintenance, and certain operating subsidies should be appropriated *only* if the municipality or county managing these facilities will permit access to all. A modest non-resident fee, bearing some relationship to additional costs of maintaining the facility, could be permitted.

5. *Local beach opportunities.* The study has identified a number of opportunities for local development of new beaches. They are all in the Sound's flood plain. Some have housing which is not structurally capable of withstanding a major hurricane and cannot be protected economically. If all of the following opportunities were developed by town or county governments, they would provide an additional 10.9 miles of beach.

Subregion 2: Plum Bank and Great Hammock Beaches, 0.9 mile (Old Saybrook); Sound View, 0.5 mile (Old Lyme); Cedar Island, 0.1 mile (Clinton); Duck Island Roads, 1.5 miles (Clinton and Westbrook).

Subregion 3: Circle and East River Beaches, 0.6 mile (Madison); Silver Sands and Momauquin Beaches, 1.0 mile (East Haven); Milford Point, 0.7 mile (Milford).

Subregion 4: Pine Creek Point, 2.0 miles (Fairfield).

Subregion 6: West of Stehli Beach, 0.3 mile (Oyster Bay).

Subregion 7: Asharoken, 1.7 miles (Huntington); West Meadow Beach, 1.1 miles (Brookhaven); Mount Sinai Beach, 0.5 mile (Brookhaven); Wading River Beach, 0.6 mile (Riverhead).

6. *Local beach additions and improvements.* West Haven, with state and federal financial assistance, should develop additional parking and beach facilities by 1980 to provide full utilization of the city beach from Sandy Point to the fishing pier (two miles). Non-resident user fees should continue to be in accord with recommendation number four above. Public transportation to the beach should serve most of the New Haven area.

Suffolk County should redevelop the beach front east of the mouth of Wading River (0.6 mile) as a county beach by 1985, with parking at the Shoreham power plant site and access across the river and marsh over a foot bridge.

7. *Beach nourishment.* In addition to the beach nourishment recommended for the beaches included in the Long Island Sound Heritage, the U.S. Army Corps of Engineers should study the feasibility of beach nourishment, to provide an average width of 300 feet, at existing beaches open to the general public. These include Ocean Beach in New London (0.4 mile), Seaside Park in Bridgeport (1.8 miles), Playland Park in Rye (0.3 mile), Crab Meadow Beach in Huntington (0.3 mile), Sunken Meadow State Park (2.3 miles), and Wildwood State Park (1.0 mile).

8. *General recreation facilities.* New York and Connecticut should acquire and develop the general recreation areas shown in Table 2.3-2 to strengthen and enhance a larger regional open space system. The figures cited merely reflect an *estimate* of development potential. Detailed site plans will have to precede development. Priorities for action are: A (by 1980), B (between 1980 and 1990), C (after

TABLE 2.3-2

Site	Town	New Park or Expansion	Recommended Acquisition (acres)	Swimming Beach	Picnic Sites	Camp Sites	Priority for Action
Susquehanna Plains	Franklin/ Sprague	New	2200	No	250	100	C
Hopemead S.P.	Bozrah	Expansion	800	Yes	500	200	B
Powers Lake	East Lyme	New	900	Yes	100	-	D
Pachaug Pond	Griswold	New	700	Yes	500	200	B
Green Fall Pond	Voluntown	Expansion	235	Yes	100	50	B
Beach Pond	Voluntown	New	450	Yes	500	200	C
Hopeville Pond S.P.	Griswold	Expansion	90	No	400	-	B
Mohegan-Pequot S.P.	Ledyard	New	350	No	200	-	A
Messerschmidt Pond	Deep River/ Killingworth	New	500	Yes	250	100	C
Chatfield Hollow S.P.	Killingworth	Expansion	160	No	100	50	C
Eustasia I.	Lyme	New	20	No	-	-	A
Hammonasset S.P.	Madison	Expansion	500	No	200	200	B
Turkey Hill	Orange	New	300	No	200	-	B
Sleeping Giant S.P.	Wallingford	Expansion	275	No	200	-	C
Buttermilk Hollow	Shelton	New	20	No	30	-	B
Success Lake	Bridgeport	New	320	Yes	250	-	D
St. Thomas/Dam Pond	East Marion	New	300	Yes	-	-	B

FIGURE 2.3-3 Proposed Recreational Ferry Service

1990), D (if, as, and when such properties become available).

9. *Recreational ferry service.* Both states, with appropriate federal aid, should either develop or franchise the development of recreational ferry service between municipalities and nearby recreation areas shown in Figure 2.3-3. In addition to providing a relatively efficient and environmentally compatible means of access to beaches, the ferry would enhance the recreation experience while it provided a non-discriminatory means of controlling public access. This ferry service should include:

Bluff Point Park to Ram Island
Essex to River Islands and Seldon Neck
New Haven to Lighthouse Point Park
Bridgeport to Pleasure Beach
New Rochelle to David's Island
Norwalk to Sheffield Island
Orchard Beach to Orchard Beach Island
Fort Totten to Caumsett State Park
Oyster Bay to Caumsett State Park
Port Jefferson to spits at the harbor mouth.

10. *Multiple use of Water Company Lands.* Connecticut should work with private water utility companies to develop limited hiking, picnicking, and camping facilities at the following locations:

- The watersheds of Lake Watrous in Bethany (50 picnic sites), Lake Gaillard in Branford (200 picnic sites), and the Maltby Lakes in West Haven (50 picnic sites).
- The watersheds of the Hemlock and Easton Reservoirs in Easton (200 picnic sites).
- The watershed of the Saugatuck Reservoir in adjacent portions of the watershed in the Housatonic Valley (300 picnic sites).

11. *Small harbor study.* The U.S. Army Corps of Engineers, working with the Coast Guard and local harbormasters, should develop detailed small boat harbor studies for each of the Sound's recreational harbors, coves, and embayments. Such studies would indicate and evaluate all authorized or proposed channels, navigational aides, and boat storage facilities, balancing the need to protect some particularly sensitive areas with the growing demands for boat storage and use.

12. *Public marinas.* The following municipalities, with appropriate state and federal aid, should develop public marinas, including small sail and power boat rentals, launch ramps, hoists, slips, moorings, and launch service: New London, Old Saybrook, New Haven, Bridgeport, Norwalk, Stamford, Rye, Mamaroneck, New York City (City Island, Little Neck Bay), North Hempstead, Oyster Bay, Huntington, Smithtown, Port Jefferson, and Greenport.

13. *Boat safety certification.* The legislatures of New York and Connecticut should amend existing legislation relative to safety certification of junior boat operators to extend to all boat operators.

14. *Right of first refusal.* The states should adopt

legislation providing first local, then state right of first refusal on any private recreation area up for sale in exchange for favorable interim tax treatment. Such private recreational areas would include beach clubs, marinas, golf courses, country clubs, and tennis courts.

15. *Shoreline mini-parks.* In addition to the various proposals for major new and improved shorefront recreation facilities, there exists a potential for increasing public access through the acquisition and/or development of minor facilities at appropriate intervals around the Sound. Such facilities should include small state and local shorefront acquisitions (see Section 2.2 Land Use and Growth). Opportunities for multiple use of public access points include power plant sites, institutional and public properties such as sewage treatment plants, sand and gravel pits, and perhaps even some country clubs. Specific multiple use possibilities are detailed in the *Recreation Planning Report*. Additional opportunities for mini-park development might include reclaimed dumps, tank farms, and land fills.

16. *Open parks and beaches to all during week.* The Connecticut Department of Environmental Protection and the New York Department of Parks and Recreation should encourage municipalities to open their parks and beaches to all people during off-peak periods of use, such as weekdays.

17. *Mass transportation.* The Connecticut Department of Environmental Protection and the Long Island State Park Commission should eventually eliminate all bus parking and access limitation at all of the Sound's state parks. In addition, both states' Departments of Transportation should immediately initiate studies of coordinated mass transit scheduling for quicker and more efficient service to the region's recreation facilities.

18. *Urban recreation programming.* Both states should encourage and share in the costs of recreation programs in the region's cities. Such programs might include boating and swimming instruction, camping, and nature study.

Sport Fisheries and Wildlife

Problems

The Long Island Sound region's wide variety of habitats and plant and animal species has in the past supported a substantial commercial fishing industry and to a lesser extent commercial hunting. Today the commercial fishing industry in Long Island Sound, despite some notable exceptions, is on the decline (See Section 2.8, Commercial Fishing). Recreational hunting in the region is at a low level and commercial hunting in the region is practically non-existent. Today, the region's natural resources make a great impact on the social and economic life of the region through their recreational value.

The recreational fishing demand is expected to increase significantly in the future, from an estimated 818,000 saltwater fishermen in 1970 to 1,122,000 by 1990, and to 1,422,000 by 2020[1]. Assuming that a sport fisherman will be content if he catches four pounds of fish each day he goes fishing (the estimated average catch in 1970), the demand for major sport fish will rise from 39 million pounds in 1970 to 54 million pounds in 1990, and to 68 million pounds in 2020. At the moment, the Sound is meeting the demand. Indeed, fishermen say that fishing these past few years has never been so good. But what of the future? Is it possible that some species are already overfished, perhaps even to the point where fish populations could suffer a severe decline? What will happen to fish populations as fishing pressure and possibly detrimental environmental impacts increase in the future?

Clearly, we do not know the answers to these questions. Information about fish populations, and the reasons for the cyclic variations of these populations is very scanty. To begin with, we still do not have reliable information about the total numbers and harvest of those fish that spend their life cycles within the Sound, winter flounder and tautog (blackfish). We know the least about the total numbers and sportfish harvest of important gamefish such as bluefish and weakfish. Most of the important gamefish, such as striped bass, bluefish, Atlantic mackerel, weakfish, and shad are migratory. It is the migratory nature of these fish that makes them particularly difficult subjects for study and/or management, because fluctuations in their population and occurrence are caused by natural and human-influenced factors both in and far removed from Long Island Sound.

Lacking accurate knowledge concerning the sportfish harvest and sportfish populations, we can only react after problems have thrust themselves upon us. By then, the situation could already have grown so severe that remedial measures will be costly and, at best, take many years to carry out. The capability is needed to detect problems while they are still small, and take management action to prevent the problems from becoming serious.

The need to manage our coastal resources has been recognized for many years. Unfortunately, the states, under whose juristiction the coastal waters fall, have had very spotty success in making coordinated management research programs work. For example, an interstate compact called the Atlantic States Marine Fisheries Commission, involving federal, state, and industrial representatives, has in the past been hampered by an inability to obtain the vital cooperation needed for the successful management of migratory finfish on an interstate basis.

More recently, however, another group called the Northeast Marine Fisheries Council, which is composed of fishery administrators and scientists from the eleven coastal states, Maine through North Carolina, together with the National Marine Fisheries Service (State-Federal Relationships program) has launched several promising programs for lobsters, shrimp, and surf clams. The Council's problem is funding, and it would not want to take on the additional responsibilities of a migratory finfish program if the effect would be to weaken its ongoing programs.

Even in the absence of specific information, it may be safely assumed that finfish populations, along with other marine organisms, suffer when their environment is degraded. Although environmental problems are still abundant, steps are now underway to preserve and restore wetlands and to improve water quality.

The destruction of wetlands has been newly halted by the recent passage and enforcement of the Connecticut

[1] Based on data in 1970 Salt-Water Angling Survey.

Wetlands Act of 1969 and the New York State Tidal Wetlands Act of 1973. These new laws recognize the importance of wetlands, which not only serve as habitat for wildlife and as nursery areas for most of the Sound's marine fisheries, but contribute to the food chain by supporting the primary producers, filtering out pollution through oxidation of organic wastes, serving as nutrient and heavy metal sinks, and acting as sediment traps for materials otherwise deposited in channels. Water cleanup programs are now underway to reduce the pollution that causes reductions in oxygen levels, adds toxic wastes, and/or covers productive bottom and benthic life, all of which are harmful to the Sound's finfish and shellfish populations and to the lower life forms on which they depend for food (see Section 2.1 Water Management). There has been some significant improvement in the Sound's fisheries as a result of recent improvements in water quality.

Another problem regarding sportfishing is that sportfishermen must have more than fish. They must also have the means of getting to them. The urban fisherman, and fishermen everywhere who are poor, young or old and do not own a boat, find access a severe problem. Fishing piers are few and often crowded. Breakwaters and jetties are sometimes barred to the public. It is not easy to find boats to rent. Often the fishing in accessible areas is not good because natural fish habitats, such as reefs, are not present.

Shellfish. The Sound's shellfish beds will also face an increase in recreational demand in the coming years. The problem here is different from recreational finfishing. Clams, oysters, and other shellfish are easier to monitor than the migratory finfish species. But although finfish and some shellfish can live in polluted waters (sewage wastes in some cases can actually increase shellfish production), polluted shellfish beds are closed to recreational and commercial shellfishing because of their hazard to health. Private commercial oystermen may remove shellfish from polluted waters for transplating to clean waters, but the recreational shellfisherman and the baymen do not have the equipment nor the incentive to do so. Therefore, while the resource may be plentiful, the public is barred from using it.

About 90,000 acres of Long Island Sound's shellfish-producing bottom are closed to the public for health reasons. The decision to close areas is made on the basis of the concentration of coliform bacteria, which are not disease causing organisms themselves, but rather presumed to indicate the presence of disease-causing agents. It might be noted that most of the closures in both the western and eastern ends of the Sound are in the shallower bays and harbors that are most accessible to the recreational shellfisherman. In the western half particularly, this is where population and recreational shellfishing demand are greatest. It must be understood, however, that it is this population density in the western sections of the Sound that has contributed significantly to the detrimental environmental impact on the Sound's waters and it is unlikely that this negative impact can be entirely eliminated. It is hoped, however, that it can be stabilized.

Wildlife. The Sound's wildlife populations are also important to the public. Sport hunters are far outnumbered by people who enjoy wildlife passively, such as bird watchers, hikers, and nature lovers. An estimate based on data in the 1970 National Survey of Fishing and Hunting indicates that approximately 210,000 birdwatchers, 150,000 wildlife photographers, and 810,000 nature hikers enjoy the Sound region's wildlife resources. Hunters, generally of small game and waterfowl in the study area, totaled about 16,000 in 1970. Apart from subregion 6, the most heavily populated region, there will be an increase in hunting demand for small game over the next fifty years. The game available to meet these demands will depend primarily on the habitat available. In the Sound region, the habitat is very limited and the hunting demand is not satisfied now. The demand will be satisfied still less over the next fifty years as the number of hunters increases. Effective management programs where natural habitat remains, can attempt to insure good hunting for as many as possible without destroying the resource.

Evaluation of alternative measures.

The objectives for sportfishing and wildlife are to maintain the natural productivity of the Sound, including the Sound's shoreland and upland wildlife resources, and to increase the economic value and public enjoyment of the Sound's marine resources. To meet these objectives, a number of alternative measures were considered and evaluated in terms of environmental, economic, and social desirability and acceptability:

Management/research programs. Although the Sound is one major type of environment, its species of direct importance to man differ in their natural history and utilization by man. Programs to manage them, therefore, must recognize these differences. As a general goal, a management program would maintain the fishery resources in a condition that will produce the optimum sustainable yield without detriment to other marine species. This requires control of two principal activities of man which affect the resource: fishing and indirect factors such as water pollution, dams, and dredging and filling activities, problems which are aggrevated by increased human population densities.

Shellfish management/research program. The states should conduct a comprehensive survey of the Sound's shellfish beds to determine shellfish abundance, shellfish harvest, condition of the resource, size of the beds, and ownership patterns (See Section 2.8 Commercial Fishing). Based on the above data, a successful management program could be initiated and strengthened.

In addition, since many shellfish beds are unavailable to the recreational shellfisherman because of poor water quality, the states should initiate programs to identify coastal areas where a small modification in sewage handling

would represent compliance with the health codes. Such programs might re-open areas to recreational shellfish harvesting.

Resident finfish management/research program. Management of resident finfish species, although difficult, should be administratively and politically less complex than that for migratory species. The winter flounder, important both commercially and recreationally, is for the most part a year-round Sound resident. Increased fishing pressures in the future could threaten the winter-flounder's present level of abundance. New York and Connecticut should gather needed data on biological parameters, such as standing crop, recruitment, total mortality, growth rate, emigration and immigration, and catch and effort statistics for the winter flounder, for both the commercial and sport fisheries as an ongoing program. Within several years, uniform management regulations could be made. In the future, the program could be expanded to include other resident finfish species, such as tautog (blackfish).

Migratory finfish management/research program. The management of migratory finfish is a particularly difficult undertaking. In most cases, not enough is known for effective management of the migratory species, and a management/research program requires the cooperation of not only the federal government, but also of the various states, the individual sport and commercial fishermen, and even international agencies.

It would, of course, be useful to have information about all these various species, and science should look forward to the day when it has a better understanding of the coastal marine ecology. However, the immediate challenge of taking advance measures for the protection of our important recreational and commercial finfish species stands the best chance for success if efforts are focused on clearly defined and readily attainable goals. A research and management program could concentrate on gathering information and monitoring, on an interstate basis, only a few of the most important species. Striped bass and bluefish, important both to the sport and commercial fisherman, and Atlantic weakfish, might be a good place to start. Research should be conducted on spawning and nursery areas for migratory species, e.g. recent biological data indicate that the Hudson River may be the primary contributor of striped bass to the North Atlantic Fishery. A continuing program of population monitoring of these species could be initiated and, on the basis of existing information, the regulations regarding size limits, closed seasons, and bag limits, for both the sport and commercial fishery could be reviewed, evaluated, and where possible, made uniform for all the Atlantic states where the species occur. This review would also include re-evaluation of the regulations regarding prohibition of gill netting and purse seining in certain portions of the Sound. These regulations relate to the controversy between sport fishermen and commercial fishermen regarding bluefish and menhaden catches as well as striped bass harvests. Many of these regulations are politically and emotionally, rather than biologically, based and stem from a basic controversy arising from disagreement over which fishermen are entitled to a major portion of the catch[2]. A partial solution to this controversy lies in public education based on biological fact. A management/research program would provide the biological data upon which re-evaluation of these prohibitive regulations could be based. After experience is gained with striped bass, bluefish, and Atlantic weakfish, the program could be extended to include other migratory species.

The migratory species management/research program could be coordinated by the Atlantic States Marine Fisheries Commission and by the Northeast Marine Fisheries Council, or other appropriate group. The work could be financed through various means, including direct appropriation through the individual state legislatures; funds presently available through the Dingell-Johnson Act of 1950, the Commercial Fisheries Research and Development Act, and the Anadromous Fish Act of 1965; NOAA's Sea Grant Program for university research; non-rebated gasoline taxes; and a small apportionment of boater registration fees.

The study carefully assessed the controversial issue of a saltwater fishing license. As expected there was considerable public opposition to this proposal, and it was omitted from the final report. Nonetheless, the study team has concluded that it is worthy of further consideration as a valid source of revenue and a mechanism for management. A good program, where the revenues would be specifically designated for sportfishing only, would have three benefits. It would directly provide revenues for a management/research program; it would result in a greater apportionment to the individual states from the excise tax on all fishing tackle returning to the states as provided by the Dingell-Johnson Act; and it would make possible far more reliable estimates of numbers of sport fishermen and sportfishing harvest. Sportsmen resistance to a saltwater license might be reduced if revenues were clearly designated solely for improving sport fishing.

Wetland preservation. Although wetlands themselves are protected, the land immediately adjacent to them could also be regulated to eliminate development and insure stricter adherence to sewage outfall and dredging and filling regulations. Also, many additional salt marsh areas could be restored if fill material were removed, the proper grading restored, and the area planted with marsh grasses. Reopening some wetland areas to tidal flushing would help to reestablish marshland. Increasing the size of road culverts, removing or not maintaining tidal impoundments, and improving mosquito ditching methods to prevent saltmarsh areas from drying out and being invaded by the common reed, *Phragmites*, are other methods of wetland management being investigated to insure growth of *Spartina alterniflora* and *S. patens*. To avoid damaging these areas,

[2]McHugh, J.L., 1974. "Biological Consequences of Alternative Regimes." In: Problems of Fishery Jurisdiction and Enforcement: The Case of the North Atlantic Region. Hamilton, Bermuda, 15 January, 1974. Law of the Sea Institute, Univ. of R.I. (in press).

access to saltmarshes could be restricted on a seasonal basis.

Wetlands are currently being restored and/or created in both New York and Connecticut, notably in Huntington and in Fairfield County. A study of the attached and benthic organisms associated with wetland creation is being made in the Huntington project.

Environmental education programs. The knowledge and understanding of the Sound's ecosystem by the general public will provide the underpinning necessary to make management and preservation programs work. Fine environmental education programs already exist around the Sound, but more are needed with a particular emphasis on the marine environment. In addition to local and state funds, the U.S. Office of Education has made Title III grants available to environmental education through the Elementary and Secondary Education act of 1965.

Establishment of additional wildlife management areas. Habitat for upland species should be protected, particularly inland wetlands which are even more susceptible to developmental pressure than are the tidal wetlands. These areas could be used for hunting, fishing, and other recreational uses.

Acquisition of islands as wildlife management areas. The very fragile ecosystems of some of the Sound's islands must be protected from overuse. While some islands can accept present casual use, for others, protection from development can be assisted by acquisition. Birdwatching, some hunting, and nature study would probably not affect the habitat of such islands. However, exposing these islands to extensive boating, swimming, camping or housing development would certainly result in considerable habitat loss.

Maintenance of or increase in upland species diversity. Maintaining or increasing species diversity could increase the numbers of upland game species and/or provide habitat for more secretive animals. It would also provide better hunting and better opportunities for passive enjoyment.

Improvement of the availability of fishing grounds. Fishing opportunities could be improved by providing the fisherman with additional fishing piers, sea walls, groins, jetties, and access to those fishing facilities at some power plant and industrial facilities. Other means of improving fishing opportunities include increasing small boat rental facilities and contructing additional boat launching ramps. It should be noted, however, that the previously mentioned management/research program, while not limiting access to fishing, could place a limit on the numbers and sizes of fish caught.

Promotion of underutilized species. Presently, fishermen throw back, or even destroy such "undesirable" finfish species as cunner, sea robin and shark. Shellfish resources, such as mussels and conch, are not heavily utilized. The recreational fishermen's take-home catch could be increased if the states, through educational programs, showed the public how to best use these species.

Alternative Plans

Two alternative plans are considered, the first emphasizing Environmental Quality (EQ), the second emphasizing Economic Development (ED).

Under an ED plan, those measures are favored which lead to a high return on expenditures. Those measures which would result in economic loss or great economic burden, such as measures dealing with water quality improvement, preservation of wetland buffer areas, and acquisition of islands for wildlife management areas would not rate favorably. The economic objections to such measures are based on either low benefit-cost ratios or outright lack of knowledge concerning their quantitative value or cost. It might be emphasized, however, that wetland preservation programs, while difficult to evaluate on a unit cost basis, can lead to economic returns, because of the wetland's role in controlling erosion, improving water quality, and increasing fishing, hunting, and other recreational opportunities. But for the purposes of this discussion, an ED plan for the Sound region would only include increasing fishing access and promoting underutilized marine species.

A plan emphasizing Environmental Quality would favor measures that insure continued natural productivity of the Sound. An EQ plan is relatively neutral to social considerations, such as improving the availability of fishing grounds or improving fishing access. An EQ plan emphasizes the role of salt marshes, the importance of preserving habitat and maintaining or increasing species diversity, and the active improvement of habitat, both for fisheries and wildlife, including measures to reduce pollution, and restore and create wetlands. In such a program, the costs and benefits cannot always be quantified, but on the whole, it is believed that benefits are high. An EQ plan would include all measures except improving fishing access and accessibility to the fishing grounds.

Recommended Plan

The recommended plan is a composite of the EQ and ED plans.

1. **Strengthen existing shellfish management/research programs.** The states, towns, and local research institutions, as outlined in the shellfish management program in Section 2.8 Commercial Fishing, should consider the needs of recreational as well as commercial shellfishermen. Measures that would specifically benefit the recreational shellfishermen include:
   a. Initiation of a comprehensive survey to determine the Sound's shellfish productivity, recreational harvest, and areas for possible shellfish development.
   b. Identification of those areas where a relatively small modification in the way sewage is handled would result in compliance with health standards for shellfishing, and encouragement of further research

into the identification of a more reliable indicator of shellfish purity than the total coliform standard. As a start in this direction, it should be noted that the Food and Drug Administration recently approved a second optional criterion, utilizing the fecal coliform organism, in lieu of the total coliform standard, for classifying shellfish growing areas. Also, restocking and maintenance of those public shellfish beds accessible to the recreational user, in cooperation with commercial shellfishermen.

c. If needed, establishment of flexible shellfish quota systems, and uniform size limits and license regulations.

2. **Establish a resident finfish management/research program.** The Connecticut Department of Environmental Protection and the New York State Department of Environmental Conservation should jointly gather needed data on biological parameters, such as standing crop, recruitment, total mortality, growth rate, immigration and emigration, and catch and effort statistics for winter flounder, for both the commercial and sport fisheries, and make any management recommendations concerning catch and size limits found to be necessary. In the future, the program should be extended to include other resident finfish species, such as the tautog (blackfish).
3. **Strengthen existing migratory finfish management/research programs.** The Northeast Marine Fisheries Council should recommend that the National Marine Fisheries Service and the Atlantic states provide funding to begin coordinated management programs for three significant sportfish, striped bass, bluefish, and Atlantic weakfish. Based on the best available biological information, tentative regulations should be recommended for the Atlantic states involved. Research should be conducted on spawning and nursery areas for migratory species. At the same time, the program should gather data on needed biological parameters, such as standing crop, recruitment, total mortality, growth rate, and catch and effort statistics for these three species, for both the commercial and sport fisheries, in order to provide the basis for management decisions that should be made within five years regarding possible catch and size limits. Year end statistics regarding fish caught during the season sould be obtained from fishing clubs, charter boat captains, and from unaffiliated fishermen, by providing forms at local tackle shops. Also, at the end of five years, this program would include re-evaluation of commercial fishing regulations enacted as a result of the controversy between sport and commercial fishermen concerning bluefish and striped bass catches. Also, at an appropriate state of accomplishment, this management/research program should be extended to include other important migratory sport and commercial species. In addition, the Northeast Marine Fisheries Council should review the advisability of an Atlantic states saltwater fishing license, which would raise revenue for the program and also facilitate the gathering of catch and effort statistics.
4. **Preserve/restore/create wetlands.** The coastal zone management programs being developed by the two states should recognize the importance of the 300-foot buffer strip adjacent to wetlands, and regulate sewage, drainage, and other development in that buffer necessary to adequately protect the wetlend itself. In addition, to provide wildlife habitat and restore marine productivity, the towns and states should create new wetland areas using treated dredge spoils and marsh grass planting.
5. **Improve water quality.** See Section 2.1 Water Management for recommended program.
6. **Establish environmental education programs.** The Departments of Education of the two states, in cooperation with the appropriate state environmental agencies, should develop a Classroom by the Sound marine-oriented program of environmental education with strong ties to the curricula of the local schools. The classrooms themselves would be established by New York's Department of Environmental Conservation and Connecticut's Department of Environmental Protection, where possible through the modification of existing facilities. They would preferably be located close to urban centers and in coastal parks to reduce traveling time for the largest number of students. Where possible, boardwalks should be constructed through wetlands. Small laboratory boats, where much of the instruction could take place, might be provided at the classroom by the Sound.

   For each "classroom" the Department of Education should provide teacher-naturalists. During the school year, the teacher-naturalist would cooperate with the local school districts on scheduling visits to the "classroom" as part of the normal school curriculum. During the summer months and on the weekends, classes would be held for the general public. Special programs would be scheduled for teacher training.

   Possible "classroom" locations include: Shea Island (owned by the City of Norwalk); Great Meadow, at the proposed Pleasure Beach State Park in Bridgeport; Nathan Hale Park, in conjunction with the Fort Hale Restoration Project in New Haven; and Hammonasset State Park, where the existing nature center could be expanded. (The New London area is already served by the Project Oceanology program located at Avery Point, Groton.) In New York, possible sites include Hen Island (Marshlands Conservancy) in Rye; and on Long Island, north shore locations such as Wildwood State Park, Sunken Meadow State Park, and Caumsett State Park. In New York City, nature "classrooms" could be located at the city parks at the southern tip of Little Neck Bay and Orchard Beach/Pelham Bay Park. See Figure 2.4-1.
7. **Increase access for fishermen.** New York and Connecticut should take steps to open up to fishermen existing

FIGURE 2.4-1 Fishing, Environmental Education

groins, breakwaters, and jetties under public ownership or regulation, or built with federal assistance. Power plants and other publicly regulated facilities should be encouraged to open up existing piers, breakwaters, and seawalls to public fishing, consistent with public safety. Existing fishing piers should be made safe, and where possible, provided with rest rooms and trash baskets. New York should build fishing piers near the Throg's Neck Bridge, and improve and expand the existing facility on City Island. Bridgeport should proceed with its plans for two additional fishing piers, and investigate other sites. New Haven should investigate building piers in the City Point area of the city. Norwalk should consider a fishing pier at Calf Pasture Beach, and the state should build fishing piers on Sheffield Island after acquisition (see Section 2.2 Outdoor Recreation). New London should consider fishing piers at Ocean Beach. In Mamaroneck, the county should proceed with the extension of the existing fishing pier, and the city should consider building a pier at Harbor Island. On the north shore of Long Island, piers should be considered at all state parks. See Figure 2.4-1.

Artificial reefs could possibly be constructed in New Haven Harbor, Bridgeport Harbor, Noroton Neck, Roton Point, Smithtown Bay, and Port Jefferson Harbor, in conjunction with fishing piers. See Figure 2.4-1.

Opportunities for small boat rentals should be expanded (see Section 2.3 Outdoor Recreation).

8. **Discourage waste of underutilized species.** The Connecticut Department of Environmental Protection and the New York Department of Environmental Conservation should publish leaflets for general distribution, particularly for sport fishermen, describing underutilized species (cunner, sea robin, shark, mussels, and conch) and methods for their preparation for consumption.
9. **Acquire additional wildlife management areas.** As part of the Long Island Sound Heritage (see Section 2.2 Land Use and Growth), Connecticut and New York should acquire four islands as wildlife management areas. These islands include Chimon in the Norwalk archipelago, Andrews and Dodges off Mystic, and Hen Island in Rye. These facilities could also provide limited nature observation, fishing, hunting, and scuba diving.

Barn Island in Stonington and Great Island in the Connecticut River should be maintained as wildlife management areas with regulated public hunting and fishing. For other island recommendations, see Section 2.3 Outdoor Recreation.

In addition, Connecticut and New York should work with federal agencies to establish a natural areas preserve/wildlife refuge system, with special attention to inland wetlands. These areas could be used for limited hunting, fishing, and other recreational uses (see Section 2.2 Land Use and Growth).

10. **Maintain or increase species diversity.** New York and Connecticut, with federal assistance, should adopt or increase utilization of those measures which will insure upland species diversity, such as periodic cutting and thinning of woodland areas, maintenance of green belts in urban areas, and promotion of old-field succession in former agricultural sites. (See also Section 2.2 Land Use and Growth and Section 2.3 Outdoor Recreation for open space proposals.)

Shoreline Appearance and Design

For many people in the region, the only, or principal, form of contact with Long Island Sound is visual. For these people, especially, interest in cleaning up the Sound and protecting its shoreline from ugly or sprawling development is directly related to how often they see the Sound and whether these viewing experiences offer any excitement or stimulus not provided elsewhere in the region. In San Francisco, relatively few people swim or boat in the Bay. Yet it is a key attraction of the city for residents and tourists alike, because it is seen from almost anywhere in the city. The water offers excitement and wonder. It harbors major commercial ships, offers superb sailing, provides refuge to many common as well as endangered bird species, produces plentiful fish and shellfish, and accommodates needs for housing, industry, commerce, parks, conservation areas, bridges, and airports along its shores. And the wonder is that so many diverse activities can go on simultaneously in and around one body of water. Yet Long Island Sound is in most respects quite similar to San Francisco Bay, except generally on a larger scale. The one key difference is the general lack of physical or visual access to the Sound.

In addition to the variety of activities to be viewed and enjoyed on the shoreline, it also offers the greatest expanse of open space in the region—the Sound—as well as many of the historic or culturally significant districts and sites in the two states. This is because the oldest settlements, the history, and the economy of the region are all closely tied to the Sound and its harbors.

Today increasing awareness and appreciation of scenic and cultural resources is amply demonstrated by the increasing popularity of historic sites such as Mystic Seaport and Sagamore Hill, the rapid growth in tourism and second home development in particularly scenic areas, the high and spiralling values of shore-front property—even when there is no beach—increased awareness of the value of protecting natural systems like wetlands, and the growth in popularity of hiking, camping, and cross country skiing which bring people into closer physical and visual contact with the natural environment.

This is especially evident along the lower Connecticut River, where the towns have established and adopted the Gateway Area Preservation Compact as a means of preserving the beauty of the local landscape through the adoption of land use standards and the acquisition of scenic easements and development rights.

The Problems

Because general concern for attractive design, high quality views, and preservation of historically, architecturally, or archeologically significant sites has only recently been receiving particular attention, many threats to the scenic and cultural resources exist today, and many of these same resources are not available to the public.

Diversity is the single most important element contributing to scenic quality. The topography of the shoreline varies from flat to gentle rise to bluff, while its contours may be straight, outward, or inward. Together, these two factors strongly influence man's pattern of development along the shore. The presence of water, birds, and variations in forms, textures, colors, hues, and tones also contribute to landscape diversity.

Several recent studies have shown that visually people tend to prefer natural to man-made landscapes. Nevertheless, the potential to create new scenic opportunities through man-made diversity, particularly around most of the Sound's harbors, does exist.

The lack of or threat to scenic diversity constitutes the major scenic problem in the region. Few scenic resources of the Sound shoreline possess qualities which could be termed spectacular, in comparison with the more dramatic shoreline of the United States. Sharp variations among scenic shoreline features do not exist in many areas. Yet observations and reconnaissance have shown that people of the region find aesthetic satisfaction in all natural shoreline areas, as well as many man-made areas of the Sound, and that diversity which is perceivable at the small-scale (natural features within a single marsh, headland, or wood's edge, for example) provide a degree of aesthetic satisfaction comparable to that experienced within a large-scale elsewhere (e.g. Cape Cod or Maine Coast).

Now, however, increasing pressures for more intense development of the shoreline threaten to make the man-made landscape far more homogeneous. The lack of diversity is evidenced by the general absence of undeveloped shoreline, only 0.95 mile of flatland with no development—none at all on Long Island—and only 2.3 miles of rise with no development in Connecticut. These and several other landscape patterns could disappear altogether with only a modest intensification of development. (For a reach-by-reach description of the Sound's shoreline, see *Shoreline Appearance and Design: A Planning Handbook.)*

An overall **scarcity of good quality views and access** to viewing points prevails throughout the Sound, particularly in subregions 4, 5, and 6, and on Long Island generally. Only 221 public viewing points of at least fair quality were identified in the region, 87 from highways and bridges, 80 from the shore, and the balance comprised of a mix of scenic overlooks, inland views, picturesque villages or harbors, views of water bodies other than the Sound, and views from institutional or private residential lands.

Visual decay and blight of urban waterfronts is common in parts of almost every harbor around the Sound. The common attitude of deference to industrial development, as opposed to public recreation, for example, has led to general neglect of the waterfront in most of the commercial harbors. The resultant accumulation of trash and refuse on the shorefront, especially in the wetlands and mud flats, creates an image of disharmony with nature. New Haven, Bridgeport, and Norwalk evidence this type of neglect. Abandoned piers, open storage of bulk materials, especially scrap metal, the proliferation of petroleum storage tanks, monolithic looking power plants, electric power transmission towers and lines, mined-out sand and gravel pits, and grounded barges (although these are sometimes very attractive and interesting) are all found in numerous ports around the Sound. Fortunately, there are ways to lessen or eliminate most of these blighted conditions.

Major facilities, such as power plants and sewage treatment plants, are not subject to any effective mechanism in their siting and design that would ensure the greatest possible visual harmony with their surroundings. In fact, not only are standards for design and aesthetics rarely made explicit in development review procedures, but reviewing institutions are also generally not staffed to evaluate scenic resources and develop standards for aesthetic improvements.

Historic townscapes, among them several town and village centers of great charm and visual quality, representative of a former time and way of life, are not adequately protected from imprudent development. Their integrity could easily be destroyed by any but the most sensitive development. Examples include the Essex village center along the Connecticut River and Head of the Harbor in Smithtown on Long Island.

Among the many other cultural sites in the region, several irreplacable sites are under immediate threat of destruction. The abundance of valuable sites—nearly 1300 of at least local significance plus a multiplicity of unrecognized sites—coupled with the limited financial resources available for their protection, raises the question of preservation priorities. Until it is too late, the public often displays little concern to save recognized portions of the region's diminishing heritage. Unidentified sites may be lost simply because no one recognized their significance.

What can be done to protect and enhance the region's shoreline appearance and design

With these problems in mind, the following planning objectives were chosen.

1. To preserve and enhance the appearance of natural landscape patterns within the coastal viewing horizon.
2. To protect and enhance scenic values of development patterns in the shoreline areas.
3. To increase opportunities for people to have pleasurable and leisurely physical and visual contact with the Sound and with the shore.
4. To increase public awareness of the region's scenic and cultural resources through public education and discussion.

The alternatives considered to satisfy each of these objectives fall under the following seven categories:

1. Adopt mandatory appearance and design criteria and standards for all new developments.
2. Adopt mandatory appearance and design criteria and standards for developments of regional impact only.
3. Adopt advisory appearance and design criteria and standards for all areas of concern.
4. Acquire key sites and areas for preservation or redevelopment.
5. Provide financial incentives to land owners for scenic preservation or rehabilitation.
6. Increase public awareness of the region's scenic and cultural resources.
7. Rely on existing tools, standards, and procedures.

Most of these alternatives will have greater effectiveness if combined with several of the others. For instance, acquisition alone would be far too costly a means of protecting every scenic and cultural resource in the region, whether threatened or not, or of insuring the rehabilitation of all visually blighted areas. Regulations will have to be utilized as well, to assure that the private sector bears some of the burden. Similarly, public awareness programs through various media can increase the public's sensitivity and appreciation of these resources. This can lead to a reduction of the threats to the region's scenic and cultural resources as well as acceptance of stricter design and appearance criteria and standards for new developments.

These alternatives were evaluated against a total of over fifty environmental, economic, and social criteria to assess their impacts, benefits, and desirability.

Major environmental considerations. Since most of the

objectives deal with preserving and enhancing the visual and cultural quality of the region, alternative measures to acquire key resources or establish design criteria receive high environmental ratings. Reliance on existing policies and regulations—in other words, not making changes in the way we deal with our scenic and natural resources—receive a low rating, since it would continue present development patterns and would eventually contribute to reduce environmental quality.

Major economic considerations. Alternative measures to achieve scenic and cultural objectives are not easily evaluated in economic terms. Economic and market forces, by themselves, do not tend to preserve scenic and cultural sites or lead to improved development design. Costs are incurred by owners who are compelled to meet design standards, by those whose property is reduced in value by regulation, and by public agencies which acquire land. The greatest public costs arise from outright acquisition.

Although benefits of improved aesthetics cannot generally be quantified, preservation of scenic lands protects wildlife and increases recreational opportunities. Development which concentrates population and economic activity, so that scenic lands can remain undeveloped, yields long term benefits in reduced costs of municipal services and travel and in energy conservation. Preservation and enhancement of the aesthetic character of the region also increases tourism and recreation activity. On the whole, measures which improve the appearance and visual enjoyment of the region need not be detrimental to the region's economy. Although short-term costs are incurred, the long-term benefits may far outweigh them in the same way that benefits arise from the sound application of land use controls such as zoning.

Major social considerations. Improved quality of life and educational, cultural, and recreational opportunities are the major social benefits of preservation and enhancement of scenic and cultural quality. These benefits also support land use, water quality, recreation, and fish and wildlife objectives and programs. Outright acquisition and the most stringent regulation receive the highest social ratings. Alternatives which call for new forms of land use control, for state involvement in local land use decisions, and for mandatory design controls rate poorly because of the difficulty of legislating and administering these programs, but rate high in terms of their long-range public and private benefits.

Evaluation of alternative plans

In all of the other planning functions, alternative plans favoring environmental quality or economic development were prepared. However, in this case all of the alternatives except reliance on existing tools and standards would apply to both, with only some difference in emphasis of each. Instead, one plan emphasizing acquisition, another regulation, and a third a combination of the first two were formulated. The three plans are summarized in Table 2.5-1.

The maximum acquisition plan would involve acquisition of all critical natural and scenic areas, scenic viewing points, lands adjacent to highway corridors, eyesore areas, and deteriorated urban areas either for permanent public management, leaseback, or resale. While this is the surest and fastest way to achieve protection of key areas and resources, it is also the most costly and would involve such massive acquisition and management programs that implementation seems impossible. This plan is summarized in Table 2.5-1.

The maximum regulation plan would rely mainly on state, county, and local regulatory action to achieve objectives. Mandatory design standards, new land use controls, new historic district and townscape regulations, shoreline and water surface zoning, advertising and architectural controls in highway corridors, requirements for public access, and enforcement of building and health codes would be involved. Although difficult to institute, especially where local home rule might be threatened, this plan would cost the public much less than the acquisition plan, but would also provide less assurance of permanent protection of sensitive areas. However, in the past, regulations have proven effective in urban areas where they have been used to govern aesthetic quality.

Recommended plan

A third plan combines the two approaches of acquisition and regulation and adds public education programs. The most important decision to be made in implementing the plan is the priorities for lands to be acquired. Priorities should be set on the basis of landscape value and ecological sensitivity, potential for public use, and threat of undesirable development.

The recommended plan is also intimately linked with the land use and recreation recommendations and is summarized in the following eight-point program:

1. **Improve visual access.** New York and Connecticut, as part of their coastal zone planning process, should develop a public access element for maximum visual and physical enjoyment of the shoreline and coastal waters by the general public. See Section Four: Carrying Out the Plan. In conjunction with this the State Department of Transportation should identify possible scenic overlooks along state and federal highways.
2. **Register of critical scenic areas.** The states, through their coastal zone planning process, should establish a list of critical natural, scenic, and historic areas within the Long Island Sound region and a priority system to guide protection and acquisition programs. See Section Four: Carrying Out the Plan.
3. **Protect scenic townscapes.** Connecticut and New York legislatures should modify existing legislation protecting historic districts to encompass entire scenic townscapes. Amendments should authorize the Commissioners of

TABLE 2.5-1 Comparison of Alternative Plans

Purpose	ALTERNATIVE PLANS		
	Maximum Acquisition	Maximum Regulation	Recommended
1. Preserve scenic natural landscape patterns	Outright acquisition and purchase of development rights	Land use regulations with design controls	Combined acquisition and regulation
2. Scenic corridor areas	Acquisition of title and/or development rights	Land use and design controls	Combined acquisition and regulation
3. Appearance and design criteria and standards for all projects		Mandatory for all significant developments	Mandatory for all significant developments
4. Scenic townscape protection		Architectural and design standards	Architectural and design standards
5. Improve appearance of deteriorated urban areas	Acquire and redevelop or remove	New zoning and subdivision controls	Combined acquisition and regulation
6. Rehabilitate or remove eyesores	Acquire and redevelop	Private action to rehabilitate or mandatory removal through codes and regulations	Combined acquisition and regulation to remove
7. Major facilities design		Mandatory design standards	Mandatory design standards
8. Harborside design and appearance	Acquire and redevelop areas	New forms of regulation based on waterfront plan	Combined acquisition and regulation
9. Protect scenic views and viewpoints	Acquire lands and easements	Use regulations including height restrictions within viewshed	Combined acquisition and regulation
10. Provide access to shore	Acquire lands and easements	Require dedication of easements as condition of land use or subdivision approvals	Combined acquisition and regulation to form greenspace system along shore
11. Highway corridor beautification	Acquire lands and easements	Regulate types and appearance of development	Combined acquisition and regulation
12. Public awareness programs			Combined intensive media programs and public discussion and education over long term

Environmental Protection and Conservation respectively to designate developed areas of statewide or regional scenic and cultural importance and establish such architectural and design controls and standards required to protect the integrity of these scenic districts. Among the townscapes appropriate for such consideration: Essex village, Stonington Borough, Guilford center, Southport Harbor, and Mystic center in Connecticut; and the villages of Roslyn, Sea Cliff, Head of the Harbor, Cold Spring Harbor, Northport, and Greenport in New York.

4. **Scenic preservation funds.** Both states should give serious consideration to the use of environment bond funds and the Land and Water Conservation Fund for scenic as well as open space acquisition. To supplement these bond funds, local efforts should utilize tax incentives and zoning, to encourage further scenic preservation. Special state attention for scenic preservation should be given to six areas: 1) the Connecticut shore and upper shorelands east of New London to the Rhode Island border; 2) the "Green Triangle" between Branford, Old Saybrook, and Middletown, particularly the ridges, valleys, and town centers; 3) the Norwalk Archipeligo, from Cockenoe to Sheffield Island, in conjunction with the island acquisition program; 4) portions of the Eaton's Neck-Lloyd's Neck area; 5) the Nissequogue-Crane Neck area; and 6) the Long Island North Fork east of Wading River. Several of the proposed Long Island Sound Heritage areas fall within these corridors. For further descriptions of the Heritage see the recommendations in Section 2.2 Land Use and Growth and Section 2.3 Outdoor Recreation.
5. **Design standards for developments of statewide concern.** The states, through their coastal zone planning process and in cooperation with other appropriate state agencies, should adopt mandatory site selection, site planning, and design criteria for all developments of statewide concern in or affecting the coastal zone. The boards should also adopt or authorize a substate regional agency to adopt mandatory site selection, site planning, and design criteria for significant developments proposed for locations within the viewing radius from the shoreline (regional viewshed). All such state standards for *nuclear power plant siting and design* must, of course, be compatible with standards established by the federal Nuclear Regulatory Commission and requirements of other federal agencies.
6. **Harbor debris cleanup.** The U.S. Army Corps of Engineers should carry out a program of harbor debris cleanup, including removal of dilapidated or rotting piers and abandoned, grounded vessels. The priority harbors are Hempstead, New Haven, Bridgeport, Norwalk, and Stamford. The program should be completed by 1985.
7. **Removal of blighted areas and eyesores.** Within the coastal zone, municipalities should be urged to use urban renewal powers to acquire and redevelop or remove visually blighted areas and eyesores which are significantly incompatible with the state coastal zone plan (once adopted). See Section Four: Carrying Out the Plan.
8. **Public education and awareness programs.** Local historical societies and regional planning agencies, with financial assistance from the Bicentennial Commission, states, and business associations, should develop regional historic and scenic tour guides to increase public awareness of the region's scenic and cultural resources. Educational programs and intensive media campaigns to make people further aware of their regional heritage should also be carried out at the local level.

Marine Transportation

Virtually all the refined petroleum products used in Connecticut and Long Island are shipped on Long Island Sound. Moreover, marine transportation on Long Island Sound is to a large degree synonymous with petroleum transportation; 80 percent of the goods that move on the Sound are petroleum, which is carried in the Sound's largest ships. Of the remainder of the Sound's marine commerce, sand, gravel, and stone for construction rank second in volume. Scrap metal, lumber, and chemicals are important at several of the ports. Although these bulk cargo receipts will increase at most of the Sound's ports, the volume will probably remain too small to warrant more than a local interest.

Demand for the three principal refined petroleum products—residual oil (for power plants and industrial heating), distillate (home heating oil), and gasoline—grew more than 5 percent a year between 1955 and 1970. At a predicted annual average growth rate of 4.4 percent from 1970 to 1990, port receipts will more than double from 160 million barrels in 1971 to 380 million in 1990. If this growth were to continue unabated, port receipts would soar to over 1.3 billion barrels by 2020. However, depletion of petroleum reserves and a corresponding rise in price are expected to force conservation and development of alternative energy sources. After 2000, it is unclear whether supply and consumption of petroleum will fall rapidly or simply level off. It is assumed that adequate supplies will be available to sustain the 1990 level of consumption.

A special mention should be made of coal. During the mid-1960s, approximately 3.5 million tons of coal were shipped on Long Island Sound. This coal traffic gradually declined as the price of coal increased relative to residual fuel. Finally, the requirements of the Clean Air Act of 1970 resulted in the complete elimination of coal traffic by 1971. However, as a result of the 1973-74 energy crisis, and the ensuing establishment of Project Independence, a resurgence in the use of coal for power plants in the Long Island Sound region may occur.

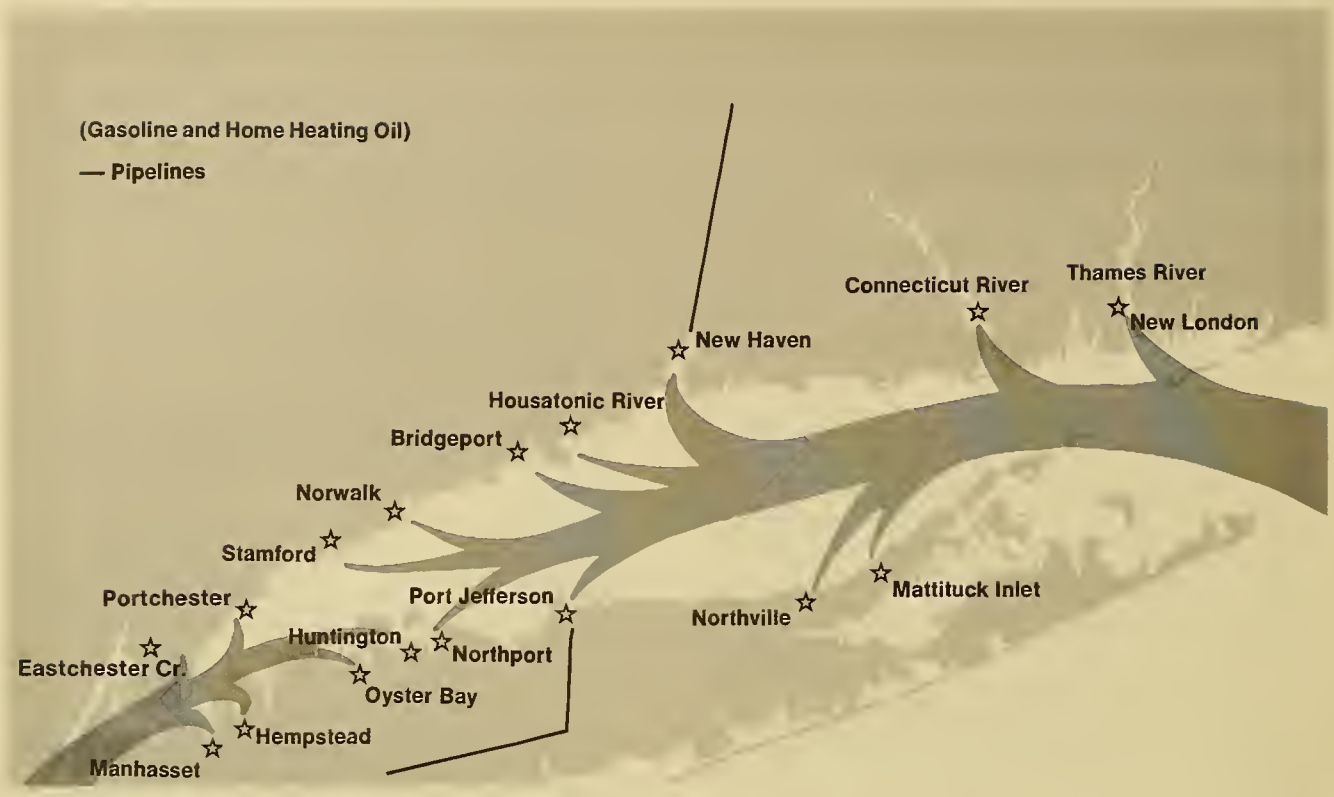
At present, the major problem in marine transportation on Long Island Sound is that too many ports in Long Island Sound receive petroleum products. Their generally shallow channels and inadequate handling facilities increase the probability of oil spills and result in higher costs to the consumer.

Of the eighteen ports shown in Figure 2.6-1—eight in Connecticut and ten in New York—none has a channel deeper than thirty-five feet; most are much shallower. Many vessel trips are required to unload the petroleum products. These trips are made both by small coastal tankers and barges, and by other vessels used to lighter off tankers which cannot enter silted-in channels. The crews on many of these small tankers and barges are poorly trained in spill prevention. Despite recent state and federal efforts at spill prevention and control, only major improvements made in the receiving systems to reduce vessel trips will reduce the attendant chance of spills.

Inefficient petroleum handling means not only a threat to the Sound environment, but also added costs to the consumer. New and somewhat larger vessels to carry refined petroleum products would result in significant economies of scale. Presently, the use of very large tankers (more than 200,000 dead weight tons) for transporting crude oil represents the major alternative to the somewhat dated fleet of small refined product tankers (less than 50,000 dead weight tons) that ply the world's waterways, including the Sound. The shipbuilding industry will be stimulated to produce a fleet of modern, refined product-carrying tankers only when ports of appropriate controlling depths (about fifty feet) in major market areas are available to serve them.

Proposals to dredge the New Haven and New London harbors (to depths of forty feet or less) and dispose of the spoils in the Sound have led to bitter controversies in the last few years, because it is feared by some that the sediment, laden with toxic industrial and municipal wastes, may cause serious environmental damage. Now the New Haven project has been completed and the one in New London is about to begin. The environmental effects of these two major projects are being carefully monitored, and will provide the answers regarding environmental threats and the needed environmental safeguards for future operations. Preliminary indications, however, suggest that the effects may be insignificant compared to the devastating

FIGURE 2.6-1 Existing Petroleum Products Flow



effect of a major oil spill caused by a tanker running aground in a poorly maintained channel.

The large number of ports also increases the opportunities for conflicts between industrial activities on the one hand and recreational and residential needs on the other. On Long Island, the pressing need to provide more recreational boating opportunity, particularly in the protected bays, could be better met if commercial traffic were consolidated to just one or two ports. Some protected bays, particularly the lower Connecticut River and Cold Spring Harbor, have so far been spared from industrial activity and oil spillage which could pollute the waters and scar the shorefront. A major oil spill in the Connecticut River might temporarily cripple that region's most important industry, the tourist trade.

Even where good economic sense dictates that petroleum handling continue in a port, the handling and storage facilities need not be located right at the water's edge. They could just as well be located inland, thus saving the shorefront for recreation and truly water-dependent commercial and industrial use, and improving its appearance, as well. Petroleum storage on the waterfront also forces trucks to use local roads from the principal traffic arteries in the cities, causing traffic congestion and noise pollution in residential areas.

Apart from petroleum transportation, the Sound could be utilized to a much more efficient extent than it is now for transporting people. People and commerce presently move between New England and Long Island over one of the East River bridges, or on ferries running between Bridgeport and Port Jefferson and New London and Orient Point. The bridge route requires a long and gas-consuming trip. The ferries are small, slow, closed several months of the year, offer no reservations, and often require vehicles to line up for more than an hour before departure. While the Rye-Oyster Bay Bridge proposal was still alive, the economic outlook for ferry improvement was dismal. With the threat of bridge competition gone, ferries have a much brighter future.

What can be done about these problems

The following planning objectives were chosen to meet the problems sketched above:

- Minimize the number of trips by oil tankers and oil barges in and out of Long Island Sound's rivers and harbors.
- Remove oil tank farms and oil handling facilities from valuable shorefront land.
- Ease highway congestion at the major oil ports.
- Reduce the amount of dredging needed to improve and maintain the rivers and harbors of the Sound, and consequently the amount of spoils disposals.
- Improve the movement of people and dry cargo.

Although the planning objectives emphasized ways to

lessen the environmental impacts of the marine transportation systems, the alternatives listed below were also thoroughly evaluated for their economic acceptability:

1. *Receiving System*
   - Channel maintenance
   - Channel improvements
   - Offshore berth
   - Pipeline from outside the region
   - Lengthen and widen ship dimensions
   - Offshore unloading from ships
2. *Handling System*
   - Expansion/modernization of existing facilities
   - New inland storage centers
   - Consolidation of existing storage
3. *Distribution System*
   - Pipeline
   - Truck
4. *People Movements*
   - Ferries
   - Hovercraft
   - Hydrofoils
   - Bridges
5. *Do Not Meet the Needs*

Some of these alternatives were dismissed quickly. For instance, a plan to bring oil into the region by a pipeline originating in New Jersey was dropped because of the extremely high costs and social disruption it would cause. In addition, New Jersey could not expand its refining capability to serve much of the LISS region. Here it might be remarked that were a refinery established in Southern New England, it could conceivably serve Connecticut by pipeline and thereby reduce some of the tanker traffic in the ports. However, opposition to such a refinery is so determined and refinery capacity and transshipment modes can vary so widely that this plan has had to assume that no new refineries in or close to the LISS region will be built. A change in this situation would require the reexamination of some of the recommendations for receiving petroleum.

Lengthening and widening ship dimensions to eliminate the need for channel deepening was found not to be feasible on a large scale because such boats would not be seaworthy, could not negotiate narrow channels, bridge openings and limited turning basins, and could not compete with new, larger vessels.

Offshore unloading of petroleum products from large tankers to smaller tankers and barges for transshipment into the ports would minimize capital expenditures for port improvements, but would significantly increase the chances of oil spillage due to the increasing number of vessels and transfer operations. This environmental threat ruled out this alternative.

Consolidating shore facilities, particularly petroleum storage tanks, within a port offers only a slight environmental advantage. Relocating the facilities away from the shore altogether is evaluated separately.

In the people-moving transportation category, hydrofoils and hovercraft were rejected for use in any frequently scheduled automobile/passenger ferry service. A vessel travelling at forty to fifty knots, even if it did not leave a wake, would require its own restricted traffic lane, thereby limiting movements of pleasure craft in one of the most popular boating areas in the world. In addition, these very large, non-displacement watercraft are generally very expensive to build and operate, and are not yet as reliable as conventional vessels.

A new cross-Sound bridge was dismissed since the most seriously considered location, between Rye and Oyster Bay, has already been rejected on the basis of its social and environmental impacts.

The other alternatives were generally assessed using forty-five environmental, economic, and social criteria. The evaluation is summarized in Table 2.6-1. Inasmuch as they were evaluated on a site-specific, rather than on a generalized basis, some of these evaluations would be altered with a change in location.

Petroleum receiving, handling and distribution. In for-

TABLE 2.6-1 Summary Evaluation of Marine Transportation Alternatives

	Receiving			Handling			Distribution		People Movements
Evaluation Criteria	Do Not Meet Needs	Channel Improvements	Channel Maintenance	Offshore Berth	Expansion Modernization	New Inland Centers	Pipelines	Truck	Ferries
Environmental	Fair	Poor	Poor	Fair	Poor	Fair	Fair	Poor	Fair
Economic	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair
Social	Poor	Fair	Fair	Good	Poor	Good	Good	Poor	Good
Applicability to alternative plans	None	ED[a]	ED	EQ[b] & ED	None	EQ & ED	EQ & ED	None	EQ & ED

a. Economic Development Plan b. Environmental Quality Plan

mulating and evaluating alternative plans for particular ports, the systems for receiving, handling, and distributing petroleum must be considered as a whole. Only when they are combined into a system is each separate component economically feasible. In fact, part of the reason the major oil companies are integrated vertically is to control these interdependent system components. In the comprehensive plan, petroleum would be brought into the region through a few key receiving ports, from which pipelines would distribute the products to the major consumption centers. These key ports could be improved either by building offshore berths, dredging to deepen channels, or both. The offshore berth is generally preferred for the following reasons: it could accommodate somewhat larger vessels--although certainly not "supertankers"--than could the harbors, thus reducing vessel trips and the opportunities for spills; it would greatly reduce dredging and spoils disposal requirements; it would probably provide cost savings to the consumer; it would free the inner harbors for recreational boating and other uses; and it would facilitate the relocation of storage tanks off the waterfront.

Offshore berths do have their limitations, however. Weather conditions make offloading unsafe in some areas for an average of thirty days a year. This would, of course, vary with the location and type of construction. Also, the tar-like residual oil can only be pumped one or two miles from offshore before it solidifies. In Connecticut, where the distance from ports to deep water is three to five miles, residual oil would still have to be brought into the harbors by tankers. On Long Island, residual oil is presently received offshore for the Northport power plant and at Northville, which serves as a transshipment depot for power plants to the west. At Port Jefferson, where a pipeline would have to run about two and a half miles, further technical and economic assessments would be required to determine whether residual oil can be delivered in this way.

Even with the development of offshore berths, some dredging would have to continue to maintain channels for dry cargo vessels, residual oil carriers, and other commercial and recreational craft.

The economic attraction of pipelines varies according to the product moved. All petroleum products except residual oil can be moved in the more inexpensive "clean" product lines. For residual oil, "hot lines" heated well over 100° F. are required to allow the oil to flow easily.

Where rights of way already exist, pipelines can have minimal adverse impacts upon people and resources. They are certainly preferable to truck transport in areas of traffic congestion and air pollution. Pipelines can generally carry petroleum more cheaply than trucks and are more reliable. They also cut down on fuel consumption. Whether pipelines are cheaper than barges, where barges are an alternative, must be assessed on a case by case basis. For example, hot lines from New Haven to Middletown and Bridgeport to Devon are expected to be less expensive than the existing barge distribution systems from Groton to Middletown and Hartford and from New Haven to Devon. This assumes that power plant use of residual will remain about static, while industrial use will continue to grow at about 4 percent a year. Gasoline and distillate similarly could be piped more cheaply from New Haven to Hartford than barged. Were pipelines to replace the barges, channel deepening in New London and Bridgeport, and both channel deepening and maintenance for oil barge traffic in the Connecticut River, would no longer be necessary. When these dredging costs are figured into the costs of petroleum distribution, the pipelines become even more economically attractive, as well as socially and environmentally acceptable. However, decisions regarding construction of new pipelines, especially hot lines, must be made in conjunction with a monitoring of the demand for alternative energy fuels, particularly coal and nuclear.

Pipelines make it possible to locate the petroleum storage tanks almost anywhere. Except for residual oil consumed by shorefront power plants, there is no overriding reason for oil storage tanks to preempt other water-related land uses from prime waterfront locations. The storage should be located inland, near major consumption centers with good highway access. Traffic through local streets would be minimized.

The storage tanks can be relocated inland over a period of ten or twenty years, as the existing tanks have to be replaced, waterfront property taxes increase, and alternative tax producing water-related developments are proposed. Since tank farms provide less taxes per acre than virtually any other industrial use, cities could maintain or increase their tax base through intensive development of only a portion of the relocated tank farm acreage, leaving the balance for recreation, public access to water, and other public uses.

Moving people. A year-round, reliable and rapid ferry service across the Sound could cut travel time and reduce traffic on the two existing East River Bridge crossings and the highways which feed them. Although most people take a ferry to save time, it also provides recreation and relaxation, and saves on fuel consumption. Presently, Long Island Sound's ferry fleet is limited to one 39-vehicle vessel (Bridgeport-Port Jefferson) and three 25-vehicle vessels (New London-Orient Point). Elsewhere in the world, giant ferries operate across many bays, sounds, and fjords. Crossing Puget Sound, Washington, for example, are a total of eighteen vessels, including two jumbo ferries which carry 206 vehicles and up to 2,000 passengers each.

Unfortunately, possibilities of expansion of the existing ferry lines crossing the Sound are quite limited. Expansion of the Bridgeport-Port Jefferson ferry is opposed by many residents of Port Jefferson because of the traffic problems it would create on the old village center. On the eastern New London-Orient Point crossing, the secondary roads running the length of the North Fork discourage truckers and other travellers bound for or coming from western Long Island.

A mid-Sound crossing, if connected to a limited access highway on Long Island, would save a large number of

people a great amount of time. It would reduce transportation costs for many goods. It would open all New England through Interstate 91 and 95 for Long Islanders, while providing access to Atlantic beaches, including Fire Island National Seashore, to New Englanders. And it would keep traffic away from the North Fork, which should be preserved much as it is today. Since the crossing time for the ferry is likely to be about an hour, it would not be of use to commuters and would not generate traffic and development the way a bridge might.

Alternative plans

In a plan emphasizing environmental quality (EQ), those alternatives that would improve the quality of the environment are selected, regardless of their cost. In such a plan, because of the ever-present danger of spills, all petroleum shipping would be replaced by a pipeline from outside the region. The handling system would be inland, because there would then be no reason for it to be placed anywhere near the water, and the distribution would also take place through pipelines, not trucks. For transportation of people, any expansion of the present system would create additional environmental disturbances and would, therefore, not rate favorably. Hovercraft, hydrofoils and bridges all rate "poor" environmentally. Not meeting the needs would rate an environmental "good."

In a plan stressing economic development (ED), those alternatives would be chosen that would enhance economic opportunity and growth, taking environmental considerations into account only if they affect operating costs. In such a plan, therefore, channels would be maintained and improved, although only where the expenditure is warranted by the economic good such an investment would bring. Selected offshore berths, since they would streamline and consolidate petroleum receiving operations, and do the job more efficiently and cheaply, rated well. For handling, the existing systems would be expanded and modernized. An ED plan would be indifferent to consolidating existing storage or moving the tanks inland. The petroleum would then be distributed by pipeline, where it is more economical to build pipelines, and by truck, where problems with rights-of-way would make pipelines too costly. In an ED plan, personal mobility ranks very high, so any means to this end—ferries, hovercraft, hydrofoils and bridges—would be desirable. However, a bridge competing with a ferry would probably make the latter's operation uneconomical.

Recommended plan

The recommended plan, an integration for the EQ and ED plans, ties together petroleum receiving, handling, and distribution. Although few of the recommended actions are seen to be a direct public responsibility, federal, state, and local governments can encourage their development through planning, financial policies, and regulatory activities. If the private sector does not take the necessary action, the state in some cases must have the authority to step in.

A map of the proposed petroleum products flow is shown on Figure 2.6-2, while a summary of recommended improvements for specific ports is found in Table 2.6-2. Additional detailed information may be found in the planning report *Marine Transportation*. The four-point plan follows:

1. **Port consolidation.** To reduce vessel trips, oil spillage, dredging, highway congestion around the ports, shorefront land consumption by storage tanks, and fuel cost to the consumer, petroleum receipts should be concentrated in five ports: New London, New Haven, Bridgeport, Port Jefferson, and Northville. The remainder of the ports may continue to receive some residual oil, sand and gravel, stone, and other bulk cargoes, but gasoline and distillate oil receipts there would gradually be phased out. To accomplish these goals, detailed study of the following actions is recommended:

a. **Offshore berths.** Offshore receiving terminals and submarine pipeline shore connections could be developed at New Haven by 1985, at Port Jefferson by 1985, and at Bridgeport in 1990, if still required.

b. **Pipelines.** Full use should be made of existing pipelines from New Haven to Chicopee, Massachusetts, and Port Jefferson to Holtsville and Plainview on Long Island. New "clean" product lines could also be built, including extension of the Holtsville-Plainview section eastward to Northville and westward into mid-Nassau County by 1980, a second line from New Haven north to the Hartford area by 1990, and a new line from Bridgeport to the Bronx by 1995. If it proves infeasible to extend a pipeline into Nassau County, an offshore berth should be seriously considered for Hempstead Harbor. Each of these pipelines could take advantage of inland tank farms.

In addition, two new "hot lines" to carry residual oil from New Haven to Middletown and Bridgeport to Devon could be built by 1985.

c. **Deepen channels.** If the recommended changes in the receiving system are made, only New Haven's harbor is likely to need deepening for commercial shipping. The New Haven channel should therefore be deepened to forty feet when the recommended hot line to Middletown is completed. The channels in New London, Bridgeport, and Port Jefferson should continue to be maintained to authorized depths, but could be deepened if the improvements were justified by a substantial increase in bulk cargo traffic. It should be noted that channel deepening represents one interim solution for relieving the existing congestion at Port Jefferson Harbor. In order to fully evaluate this option, the U.S. Army Corps of Engineers should quickly complete its current investigation of its feasibility and environmental impacts.

d. **Limit tanker size.** The currents and shoals at the entrance

TABLE 2.6-2 Summary of Recommended Plan for Petroleum Receiving, Handling and Distribution

Port/Product	1971 Receipts[a]	1971 Storage[b]	1990 Receipts[a]	Additional Storage Needed[b]	Recommended Program
NEW LONDON					
Distillate	1.2	3	2.3	0	Maintain 36' channel; phase out barge traffic to Connecticut River ports.
Residual	2.3	13	3.6	0	
Total	3.5	16	5.9	0	
THAMES RIVER					
Distillate	1.1	1.0	2.3	0	Maintain 25' channel.
Gasoline	0.5	0.3	1.0	0.2	
Residual	3.4	c	3.6	c	
Total	5.0	1.3	6.9	0.2	
CONNECTICUT RIVER					
Distillate	5.0	3	9.1[d]	0	Phase out all oil barge traffic by 1985; replace by use of existing "clean" line, New Haven to Hartford to Springfield, and a new hot line from New Haven to Middletown.
Gasoline	8.5	4	17.2[d]	0	
Residual	8.6	5	17.7[d]	0	
Total	22.1	12	—	0	
NEW HAVEN					
Distillate	17.7	10	41.3	28[e]	Develop offshore berth by 1985; build "hot" line to Middletown by 1985 and second "clean" line to Hartford by 1990; deepen channel to 40' by 1985.
Gasoline	16.3	13	50.6	17[e]	
Residual	14.0	12	43.8	12[f]	
Total	48.0	35	135.7	57	
HOUSATONIC RIVER					
Residual	2.3	0.5	4.7[g]	1.9	Residual by "hot" line from Bridgeport by 1985.
BRIDGEPORT					
Distillate	3.1	3	20.8	3	Develop offshore berth by 1990; build "clean" line to Bronx by 1995 and "hot" line to Devon by 1985; expand Johnson's Creek facilities for storage; maintain 35' channel.
Gasoline	3.5	2	28.1	4	
Residual	9.9	6	15.7	0	
Total	16.5	11	64.6	7	
NORWALK					
Distillate	1.2	0.6	2.2[g]	1.4	Receive distillate and gasoline via Bridgeport-Bronx pipeline by 1995; new inland tank farm along pipeline route; maintain 12' channel.
Gasoline	0.1	0	0.2[g]	0.6	
Residual	0.6	0.4	0.9	0	
Total	1.9	1.0	—	2.0	
STAMFORD					
Distillate	3.2	4.0	5.8[g]	1.0	Receive distillate and gasoline via Bridgeport-Bronx pipeline by 1995; new inland tank farm along pipeline route; maintain 15' channel.
Gasoline	0.9	0.5	1.7[g]	0.3	
Residual	0.5	0.2	6.0	2.8	
Total	4.6	4.7	—	4.1	

Footnotes on second page.

TABLE 2.6-2 Summary of Recommended Plan for Petroleum Receiving, Handling and Distribution (Cont'd)

Port/Product	1971 Receipts[a]	1971 Storage[b]	1990 Receipts[a]	Additional Storage Needed[b]	Recommended Plan
PORT CHESTER					
Distillate	1.1	0.7	2.0[g]	1.0	Products received via Bridgeport-Bronx pipeline by 1995.
Gasoline	0.6	0	1.1[g]	0.7	
Residual	0.2	0	0	0	
Total	1.9	0.7	–	1.7	
EASTCHESTER CREEK					
Distillate	2.9	2	5.2[g]	3	Products received via Bridgeport-Bronx pipeline by 1995; additional storage along pipeline route.
Gasoline	8.5	4	17.4[g]	6	
Residual	0.4	0	0.7	0	
Total	11.8	6	–	9	
MANHASSET BAY					
Distillate	2.9	3	5.0[i]	0	Shift receiving to Port Jefferson and Northville by 1980, with pipeline to mid-Nassau Co.; locate all storage tanks at pipeline terminus.
Gasoline	1.0	1	2.1[i]	0	
Residual	0.1	0	0	0	
Total	4.0	4	–	0	
HEMPSTEAD HARBOR					
Distillate	2.0	1	3.6[i]	3	Maintain 13' channel; shift receiving for distillate and gasoline as indicated for Manhasset Bay.
Gasoline	4.9	3	9.3[i]	3	
Residual	2.7	1	2.9	0	
Total	9.6	5	–	6	
OYSTER BAY[h]					
Distillate	2.0	1	3.6[i]	0	Shift receiving to Port Jefferson and Northville by 1980, with pipeline to mid-Nassau Co.; locate all storage tanks along pipeline.
Gasoline	1.0	0.5	2.0[i]	0	
Residual	0.1	0	0	0	
Total	3.1	1.5	–	0	
NORTHPORT					
Residual	8.4	10	21.9	0	Maintain present facilities.
PORT JEFFERSON					
Distillate	8.9	7	24.8	9	Develop offshore berth by 1985; maintain 26' channel; extend pipeline from Holtsville to mid-Nassau Co. by 1980; locate all storage, except residual, inland along pipeline route.
Gasoline	6.6	4	7.8	1	
Residual	6.7	4	7.2	0	
Total	22.2	15	39.8	10	
NORTHVILLE					
Distillate	5.3	5	16.2	10	Complete pipeline, Northville-Holtsville-mid-Nassau Co. by 1980; new storage along pipeline route.
Gasoline	0	0	19.2	10	
Residual	15.0±	11	0	0	
Total	–	16	35.4	20	

a. Receipts expressed as million barrels. b. Storage expressed in acres.
c. Storage provided at Groton for Thames River market area. d. Amounts are included in New Haven 1990 receipts.
e. Additional and existing storage should all be at inland storage centers—in general area of New Haven, Meriden, and Hartford.
f. Storage areas at Bridgeport, Devon, New Haven, Middletown, and Hartford. g. Amounts are included in 1990 Bridgeport receipts.
h. Residual projections were developed prior to assumption that coal and other fuel sources are likely to reduce future dependence on oil-fired generators for base load electric power. Assuming that the electric power use remains relatively constant and industrial use continues to grow at about 4 percent/year, the recommendations would still be justified.
i. 1990 clean product flow has been re-routed and balanced between Port Jefferson and Northville ports.

FIGURE 2.6-2 Proposed Petroleum Products Flow

of the Sound represent natural hazards to safe navigation for very large petroleum-laden vessels. Developers of offshore berths should therefore be required to file an environmental impact statement indicating, among other things, proposed vessel size, routes, and provisions for safety and maneuverability. In no event should tankers larger than 150,000 dead weight tons or drawing more than 55 feet be permitted in Long Island Sound.

The result of this port consolidation should be a faster, cleaner, safer, and cheaper distribution of goods in the region. Nearly all shipping of petroleum products to points west of Bridgeport and Port Jefferson, except to oil burning power plants, would be phased out. Oil barge traffic on the Connecticut[1] and Housatonic Rivers would similarly be phased out, obviating the need for dredging to depths greater than those required for recreational boating. The plan would also reduce federal channel dredging requirements by several million cubic yards for substantial savings to the taxpayer over the next twenty years.

2. **Establish petroleum receiving and distribution authority.** New York and Connecticut should each establish petroleum receiving and distribution authorities (PRDAs), or lodge appropriate authority within existing agencies. In either event, they would be responsible for constructing offshore oil terminals and pipelines, siting new oil tank farms, and leasing these facilities to petroleum distributors. Such authorities should be publicly appointed and include, among others, representatives of the general public, local officials, private industry, and the U.S. Army Corps of Engineers. Through powers of bonding and condemnation, these authorities could raise funds, acquire rights of way, and construct key facilities, particularly the pipelines, more speedily than the private sector.

The PRDAs, in cooperation with the energy agencies of the two states, would continually monitor new developments and trends in power production and consumption, taking care that new petroleum facilities will not encourage a continuing dependence on fossil fuels at the expense of alternative, non-nuclear energy forms and energy conservation.

3. **Relocation of tank farms inland.** The PRDAs should develop new oil tank farm sites which satisfy all environmental regulations and recommended design criteria (see Section 2.5 Shoreline Appearance and Design). The effect of this would be to both encourage the gradual relocation of existing waterfront storage tanks inland, and provide additional sites for needed expansion. Relocation should proceed consistent with the coastal zone plans being developed by each state. (See Section Four: Carrying Out the Plan.)

4. **Ferry Service.** Both states should give serious consideration to a competitive bid procedure for the operation of a year-round ferry service from New Haven to Shoreham.

[1]The effect of this recommendation is to amend the NERBC 1980 Connecticut River Basin Plan.

The successful bidder would provide the stipulated service for either the highest net fee payment to the states or the lowest net subsidy from the states. The results of the study presently being conducted by the Tri-State Regional Planning Commission on this and other routes should provide the basis for the conditions of operation and estimated operating expenses.

5. **Rail Freight Service.** The preceding recommendations, if implemented, would improve the movement of goods to Long Island Sound ports, and expedite the movement of people and cars across the Sound. To improve goods movement from Long Island to the mainland, the study has concluded that railroads represent a significant regional opportunity. As part of the current examination of northeast rail service, the study recommends:

a) Reexamination of a New York Harbor rail freight tunnel crossing.

b) Implementation of the Tri-State Regional Planning Commission recommendation to repair the Poughkeepsie bridge and renew freight service over it.

c) Improvement of rail freight service over the Hell Gate Bridge between the Bronx and Queens.

Power and the Environment

Recent energy shortages, increased prices of all energy forms, especially fuel oil, and the potential for summer brownouts in parts of the region have fostered a new public awareness of the vital role which energy plays in our society. Whether it is through a fuel cost adjustment charge on the electric bill or shortages of plastics and other common products dependent on petrochemicals, the public has a new understanding of the importance of energy in sustaining the economy and protecting public health. With regard to electricity in particular, the study has concluded that the social and health consequences of an inadequate supply can be far greater than the hazards associated with generating this electricity.

Electric power as a part of the region's total energy demand is expected to increase steadily in the next few decades, requiring an increase in the number of power plants. Well conceived public policies will be needed to guide their location, minimize adverse impacts of power generation and distribution, and minimize wasteful energy use.

In order to project future electric power requirements and determine how best to satisfy them, it was necessary to look beyond the study area boundaries. The selected power Market Area, shown in Figure 2.7-1, consists of the service areas of all the utilities in the New England Power Pool and the New York Power Pool. The utilities in each power pool have interconnections with one another, so that in case of a temporary power shortage in any one of the utilities, any other in the pool with excess capacity could make up the deficiency. This is an essential reliability factor and permits each utility to maintain a much lower reserve capacity than would otherwise be possible.

The Long Island Sound Service Area consists of the service areas of all the utilities serving portions of the study area. It comprises all of Connecticut, New York City, Nassau County, Suffolk County, and part of Westchester County. This is the smallest land area which the study was able to use in projecting future power demands, and how and where they might be accommodated.

On the basis of past trends, but tempered by an expected decreasing rate of population growth, saturation of appliance use, and increasing public pressure for conservation, projected power requirements in the Market Area were developed. The Market Area's growth rate in electric power demands over the past thirty years has steadily increased. Between 1940 and 1950, the annual rate of growth averaged 5.1 percent and increased to 5.6 and 6.4 percent in succeeding decades. Without any major public policy changes on energy growth or conservation, this growth rate would be expected to peak and then gradually decline during the present decade. Nevertheless, future demand for electric power would still be expected to be governed by a compound rate of growth far in excess of the projected population growth rates. The future energy demands projected under these conditions for the Market Area were then allocated to the Service Area with the assumption that past supply patterns would generally continue.

These estimates for future Market and Service Area supplies, including needed reserves, are shown in Table 2.7-1. This table is based on long-term trends from which there has been considerable divergence in the last two years due to the energy crisis, conservation practices, and the economic recession. Should the recently observed reduction in demand continue at its present rate, substantial changes in the projected power demands for the region could result.

TABLE 2.7-1 Existing and Projected Power Demands

Year	Market Area Power Supply (Megawatts)	Service Area Power Supply (Megawatts)
1971	37,700	18,100
1980	67,900	30,500
1990	121,400	55,200
2020	499,500	244,000

*Source: *Power and the Environment Report.*

FIGURE 2.7-1 Power Study Area Identification

These estimates show a three-fold increase in capacity in the Service Area between 1971 and 1990 and nearly a fourteen-fold increase from 1971 to 2020. It now appears that the projected 1980 and 1990 demands may not be reached until a somewhat later date.

The implications of these forecasts for the Sound are great, since its waters represent the largest potential source of cooling water and its shoreline the greatest number of potential new sites in the Service Area. The study area now provides about 30 percent of the Service Area's power capacity. This share will probably remain fairly constant in the future. Other major potential power plant siting areas within the Service Area include the lower Hudson River and the major rivers and lakes in Connecticut.

What are the problems in satisfying these demands

The most overwhelming problem suggested by these demands is the sheer enormity of *energy consumption increase* in the face of worldwide concern about the availability of sufficient resources to provide this generation in an environmentally acceptable manner, the simultaneous multiplying safety risks, and the spiralling costs of electricity as fuel prices increase. The lack of national energy self-sufficiency and the resultant potential threat to the national welfare dictate that all wasteful energy uses be eliminated. There is also a national responsibility with respect to the larger world community. In a world with scarce energy resources available, the United States cannot continue to consume a disproportionate share of the world's energy production.

In the past year, many people have seen their electric bills double. This is almost certainly only the beginning of further multiplying of electricity costs as new exotic technologies are introduced, fuel costs raised, and added costs incurred to make sure that the exploitation of the energy resources and power generation do not violate existing environmental regulations and standards. Several studies have documented that the lower income groups are the hardest hit by these increased costs. The nation will have to move with great speed to relieve this disproportionate burden and assure that it is not further exaggerated by future developments.

Since oil will become increasingly valuable in the future for uses other than electric power production, increasing

dependence, at least through 1990, is likely to be placed on nuclear power. Although nuclear plants are very carefully designed and sited, continuing questions of safety from many responsible scientists and the general public regarding nuclear power plant operations, especially disposal of their radioactive wastes, merit a very cautious approach toward adding nuclear capacity. If capacity additions can be delayed without major social or economic repercussions, they should be in order to benefit from increased experience with present units and additional research into possible ways to further reduce safety risks.

Many of the problems in the electric power field are related to specific environmental impacts associated with electric power generation and distribution. Most pertinent to Long Island Sound are the *effects on aquatic life from the intake of cooling water and discharge of heated waste water* to the Sound or its tributaries. Generating facilities currently take in over four billion gallons of water from the Sound every day, pass it once through their cooling systems, and return it to the Sound an average of twenty degrees (F) warmer than when it was taken out. The full environmental effects are not well understood. Many are very subtle, and in some instances there may be beneficial as well as harmful effects. Harmful effects involve reduction in fish hatch and greater mortality in the development stages. A plant shutdown during periods of cold weather can also cause "thermal shock," where fishes attracted to the mixing zone of the heated effluent are unable to adjust to the sudden temperature drop and die. Fish kills of this nature have occurred in the Sound, but never to the extent of affecting the fishery population in the Sound.

Some of the beneficial effects of the thermal discharge may include more rapid development of eggs, faster growth of larvae, fingerlings or juvenile, and larger fish of some classes (depending upon the timely availability of food in trophic chains). At the Long Island Lighting Company's Northport power plant, the thermal discharge has been used productively to stimulate oyster and clam growth. Aquaculture opportunities may occur elsewhere as well.

The real regional issue on thermal wastes, however, is whether all of the projected power plants around the Sound will raise the average temperature of the Sound, and whether this rise will have significant effects on the biota. Evidence available today, although not complete, suggests that the overall temperature rise in the Sound will be considerably less than one degree F between now and 1990. This is hard to discern among the other natural temperature variations due to climate, amount of sunlight, movement of the Gulf Stream, and other factors. The thermal effect may be a significant local problem, but probably not one of Sound-wide significance.

Harmful effects on the marine life are due also to entrapment on intake pipe screens and entrainment in condenser cooling systems. Fish and crustaceans can become trapped in the screens intended to keep debris out of the intake. Although the numbers of organisms trapped daily is usually not significant, on infrequent occasions when large numbers of a particular fish species are present in the Sound, the number entering a power plant intake may rise suddenly. Although the number of fish entrapped in these instances may be hundreds or even thousands of times greater than normal, these fish losses are low compared to the total population of these species then present in the Sound. Improper intake siting, however, might cause major long-term damage to a fishery. Each new siting or design proposal in the Sound will have to be scrutinized carefully to assure than chances of significant fishery damage may have been minimized.

Those organisms small enough to pass through the intake screens and into the plant's condensers are subject to mechanical, thermal, and chemical stresses. The effect of these stresses can result in high or total mortality for certain species. The number of organisms entrained depends upon the numbers present in the waters around the intake and the intake design. With presently used designs, there is no way of completely preventing these organisms from entering the condenser cooling water system. However, the number of organisms killed represents a very small fraction of the population of these species in the Sound. We do not know with the present number of power plants in the region, whether even a high level of mortality of entrained organisms would have a significant effect on the total population of the organism, or whether there would be any impact on species higher in the food chain which are dependent on the organism. We do not know how many more plants could be tolerated before these effects would become significant. However, the capacity is certainly not unlimited. Continuing research at various coastal and inland power plant sites, including several on the Sound, hopefully will develop measures to further reduce chances of deleterious environmental impacts due to entrainment.

Another major environmental and social concern and potential problem is the danger of a major radiation accident either at a nuclear power plant or in the transportation or disposal of radioactive wastes. The Atomic Energy Commission (now Energy Research and Development Administration) states that no member of the general public has received a radiation exposure in excess of prescribed standards from the operation of civilian nuclear power plants in the United States, nor have these plants experienced accidents of any type affecting the general public. In addition, a recent ERDA study of accident probability and consequences had indicated the probability of significant accidents to be very low and less than non-nuclear accidents of equivalent consequences which are normally encountered by society. Nevertheless, some expert scientists and engineers still have reservations about the absolute safety of nuclear reactors. Most criticism has been aimed at the emergency core cooling systems (ECCS), the mechanism designed to prevent major radioactive release in case of an accident. This resulted in a total of 125 days of hearings recently conducted by the Nuclear Regulatory Commission, new regulations governing emergency core cooling systems in light-water reactors, and a method of analyzing accepta-

bility of these systems in order to ensure their adequacy in all reasonably hypothesized ECCS situations.

The safety of permanent disposal systems for the highly radioactive used fuel from the reactors has been the other major area of controversy. These irradiated fuels are reprocessed and the resultant high level wastes are concentrated, stored temporarily in tanks, and transformed into solid materials at reprocessing plants. Finding permanent disposal sites for the solid wastes, which may have a radioactive lifetime of tens or hundreds of thousands of years, has aroused considerable controversy. Although the ERDA believes that engineered storage facilities or underground disposal in selected geologic formations in certain sections of the country are feasible for safely isolating hazardous wastes from the biosphere, safeguards to monitor these sites for any leaks to the air, water, or other subsurface geologic deposits, as well as contingency programs, may be required before any permanent disposal sites are approved.

Despite safety assurances from federal and state agencies, there are counter views from qualified experts and unresolved waste disposal probelms which have resulted in public apprehension and mistrust of nuclear plants and the responsible regulatory agencies. This lack of public confidence will be a major factor in future siting decisions. If energy consumption rates continue to decline, it would have a two-fold effect. It would delay plant construction, thus allowing more time to develop better trusted technologies, and prevent major social and economic disruptions that would follow a shortage of electric energy. A pervasive shortage would most likely give rise to a headlong rush in construction that would undo today's stress on environmental values.

Other types of power plants also have their own special environmental problems. *Air pollution from fossil fuel plants* is the most prominent. The noxious gases–oxides of sulfur and nitrogen, and organic compounds including poly-nuclear hydrocarbons–produced by oil and coal burning plants are harmful to plants, humans, animals, and materials. Controls are available for particulates, but there are presently no fully tested, commercially available removal systems for the oxides of nitrogen and sulfur. In addition, some pollutants in combination with others, such as sulfur oxides and particulates, have been shown to exhibit effects several times more severe than comparable exposure to either pollutant alone.

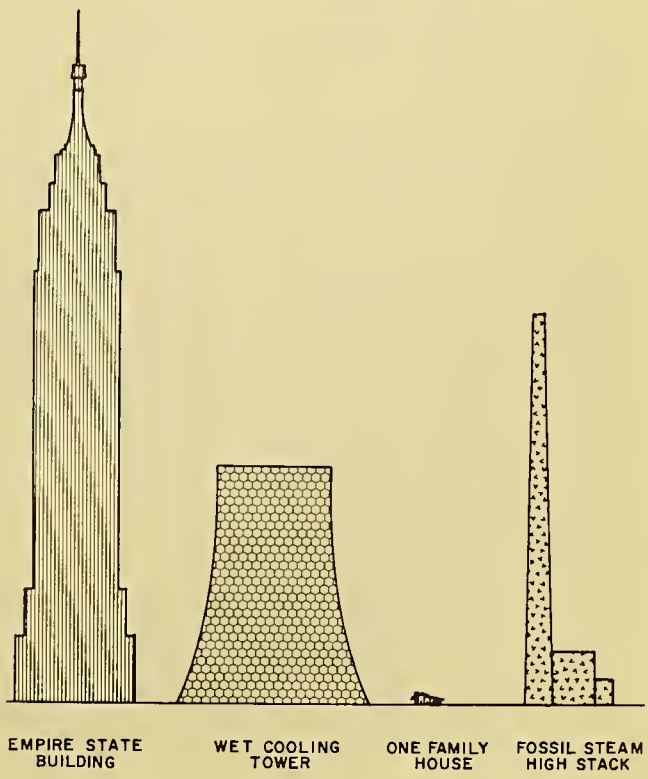
Nitrogen dioxide, under the action of sunlight, may cause smog and produce ozone, a highly irritating gas and a health hazard. This is especially critical in the western half of the study area, where the corridor from New York City to New Haven, and possibly Long Island as well, is presently in violation of federal air quality standards for carbon monoxide and ozone. Although automobiles are responsible for the largest share of this smog and ozone, fossil fuel plants represent the largest point sources contributing to the pollution. These high air pollution levels have been responsible for both states turning down recent utility company requests to switch to high sulfur fuels in fossil plants.

Another environmental problem is the frequent *aesthetic degradation caused by generating units, cooling towers, and transmission towers*, either in the form of visual blight or excessive local noise.

Fossil fuel plants not only have problems with high stacks, but also with extensive storage areas and handling equipment, which aggravate the task of concealment. Nuclear plants pose the problem of large containment vessel structures although, for a given size plant, they cause much less visual impact than equivalent capacity fossil plants. Hydro plants often intrude on scenic areas, and may preclude other development of the water source. Gas turbine and internal combustion plants can cause increases in ambient sound levels and create visible plumes.

Cooling towers are required in many cases for thermal power plants located on inland and estuarine as well as coastal waters. If mechanical draft towers are used, the structures may be several hundred feet long and approximately 60 feet high, while natural draft towers, hyperbolic in design, may typically be 500 feet high and 400 feet in diameter at the base. See Figure 2.7-2. Both natural draft and forced mechanical draft towers discharge water vapor into the air. This may create fog banks, snow, rain, sleet, or ground ice under certain atmospheric conditions. The plumes from these giant hyperbolic towers present less of an environmental problem than those from the forced draft systems, but this may not prove to be compensation for their enormous size and aesthetic impact. In both cases,

FIGURE 2.7-2 Comparative Sizes of Major Power Plant Structures With Familiar Buildings



noise levels associated with the towers can constitute a major nuisance as well.

The final component of the electric power system which engenders complaints on aesthetic grounds is the transmission network required. Transmission facilities probably generate more complaints from the public than all other facilities combined. Although transmission towers, which can be over 125 feet high, can themselves be visual blights, a great many of the industry's critics feel that it is not so much the structures themselves that offend scenic sensibilities as the right-of-way clearings in which they are placed. This problem is more obvious in older rights-of-way, where either new development has sprouted around or under the transmission corridors, new towers which are incompatible visually with the original towers are being added, or excessive cutting of the vegetative buffer within the right-of-way is required. However, in most instances, where new or replacement towers are placed in a right-of-way, the new structures are less obtrusive than the older ones. Until the latter have been replaced, however, the temporary situation of two or more seemingly incompatible tower designs together on the same right-of-way appears disharmonious.

In obtaining new rights-of-way, many forward-looking utilities have taken great care to insure proper placement. Attempts have been made to locate lines away from highways or other public gathering places, and use transportation or industrial corridors or existing rights-of-way for siting new facilities. In any event, structures can be located away from skyline ridges, to avoid using the sky as a backdrop. If ridge-top structures cannot be avoided, limited height trees planted along the ridge under the transmission line help to make the right-of-way gap less obvious.

What are the alternatives to deal with the electric power needs and problems

With the above problems in mind, the following planning objective was chosen: to develop a program to provide for future electric power requirements in a safe and reliable manner while minimizing possible harmful environmental impacts. Choices to meet future power needs and attendant problems revolve around four basic areas: (1) plant siting and the amount of power to produce, (2) alternative energy forms, (3) cooling system alternatives, and (4) overhead versus underground transmission lines. One method for profiling energy alternatives is shown in Table 2.7-2.

Power plant site selection can be accommodated by: (1) more efficient or intensive use of existing power sites, (2) new urban sites, (3) new rural sites, or (4) offshore sites. The first option is usually the most acceptable solution to power plant siting. Unfortunately, increasing the capacity of existing sites cannot meet the area's total future needs. There are two ways of providing more capacity at current facilities. Where land is available for the addition of future units, the total capacity of the site can be increased without a concurrent increase in supportive facilities. In the other case, an existing unit can be retired from service and the site reused for a larger, more efficient unit. In most cases, reuse of the site requires demolition of existing stacks, clearance of appurtenant structures, and costly site restoration. However, these older sites, with proper architectural design, can be upgraded to meet standards and should be reused wherever possible.

New urban sites, under present-day restrictions, are confined to fossil fired units. The large fossil steam plants presently account for 80 percent of the generating capacity in the study area, and 70 percent in the Service Area. There are supplementary combustion units for peaking power. Although fossil fuel plants produce the major share of our electric power, limited reserves of oil and natural gas will probably place a limit in the forseeable future on their acceptability as generation modes. Of the fossil fuels, only coal is plentiful, accounting for 80 percent of the nation's natural fuel resources. It has, therefore, been suggested that near-term alternatives for power generation in the Service Area could include a possible return to coal. Low sulfur coal could be used now, but burning of the cheaper and more abundant high sulfur coal would violate present air quality regulations. Improved flue gas treatment technology would have to be perfected first, and this technology will probably not be fully available commercially until the late 1970s. To expect that residual oil will be in such abundant supply in the next several decades, considering the plant's expected lifetime of about thirty-five years, that oil-fired units could provide the major share of the expected future base load requirements would seem highly risky and unrealistic in view of our recent energy shortage experiences. Reliability of electric power supply must be an overriding consideration in the economy, health, and welfare of the region and nation. Oil-fired units alone should not be depended upon for this future reliability.

New rural sites generally include nuclear fueled facilities, although fossil fired units can also be accommodated. In 1972, nuclear plants accounted for only 12 percent (662 MW) of the study area's generating capacity. However, an additional 1,700 MW nuclear capacity is under construction at this time. Nuclear power has advantages over fossil power in lower fuel costs, a more reliable fuel supply, and a lack of noxious combustion emissions. Nuclear power also has aesthetic and land use advantages, since it does not require tall stacks or large areas for the storage of fuel. It does require, however, considerably more land, mostly undeveloped. Another drawback of current nuclear plants is lower thermal efficiencies (34 percent as compared to about 40 percent for the most advanced fossil fuel plants) and the resultant requirement of about 40 percent more cooling water. Without any new alternative technologies for base load power expected to be available and in service much before 1990 (considering the 8-12 year lead time from initial application to power production), it is expected that the bulk of new base load capacity in this region during this period will be provided by light water nuclear power

TABLE 2.7-2 Comparative Environmental Profile of Base-load Alternatives[1]

		OIL-FIRED	COAL-FIRED	NUCLEAR
A.	*Fuel Supply*			
	1. Production	Production and refining of sufficient crude oil to yield 40,000 barrels of fuel oil per day. This roughly corresponds to the fuel-oil output of a large oil refinery.	Mining of 8,000 tons of coal per day.	Mining and milling of 75,000 tons of uranium ore per year. Processing and fabrication of 150 tons of uranium metal per year. If by-product plutonium is recycled, 1000 lbs. per year of plutonium would require processing and fabrication under equilibrium conditions.
	2. Transport	One supertanker delivery of crude oil every 3 or 4 weeks, or, in the case of the larger tankers now serving U.S. ports, 1 delivery every 2nd or 3rd day.	Daily unit-train delivery (105 rail carloads).	6 truckload deliveries per year.
	3. Storage	Storage of a 3-month fuel-oil supply would require 20 large oil storage tanks (one million cubic feet each) occupying 20 acres.	50-acre coal pile, assuming 2-month reserve.	Nominal.
B.	*Power Plant*			
	1. Installation	70-acre plant site (assuming cooling towers used).	250-acre plant site (assuming cooling towers used).	500-acre plant site, mostly undeveloped.
	2. Operation	Discharge of 120 billion BTU of waste heat per day; emission of 70 tons/day of sulfur or SO_2 (assuming low-sulfur fuel oil being burned), 30 tons/day of nitrogen oxide and other gaseous effluents, and 0.5 tons/day of particulates.	Discharge of 120 billion BTU of waste heat per day; emission of 150 tons/day of sulfur or SO_2 (assuming use of stack gas desulfurization system, not yet commercially available), 60 tons/day of nitrogen oxide and other gaseous effluents, and 9 tons/day of particulates (assuming use of highly efficient precipators and scrubbers.	Discharge of 160 billion BTU of waste heat per day; emission of trace amounts (a few hundred-thousandths of a gram per day) of radioactive substances containing 2 curies of comparatively long-lived radioactivity. Shipment of 60 canks of spent fuel per year (60 truckloads or 10 railroad flat car-loads.
C.	*Waste Disposal*	Minor problems.	Disposal of 1200 tons/day of fly ash and 1600 tons/day of sulfur, based on 3.5% sulfur coal and assuming 80% stack gas desulfurization efficiency.	"Perpetual" storage of solidified high-level radioactive waste concentrates from spent fuel reprocessing, which, in calcined form and with inert diluents, accumulate at a rate of 100 cubic feet/year. Also land burial of 200 cubic feet/year of miscellaneous low level radioactive waste materials.

1. This exhibit lists the principal ways in which the fueling and operation of base-load power generating facilities interact with the natural environment. Some details, such as the release of modest quantities of chemicals used to prevent fouling of tube surfaces in the steam condenser portion of the turbine generator system are not shown. Also, the transmission and distribution of the power produced are not covered. All quantities shown are approximations and, with the exception of site acreage, relate to a single 1150 KW unit or the equivalent.

From a report prepared by Arthur D. Little, Inc. for Northeast Utilities, *A Study of Base Load Alternatives for the Northeast Utilities System*—July 5, 1973. This table presents a generally valid comparison, although various New England River Basins Commission members have suggested changes in the numbers to bring them slightly more up-to-date.

plants.

As a relatively new concept of power plant siting, *offshore siting* can be judged under two modes – natural islands and artificial sites, including barge-mounted plants with breakwaters. Problems associated with conventional sites seem to be carried over to natural islands. Recently, plans for offshore power installations have met with public resistance, since many land and water features in offshore locations are as controversial as those onshore. Artificial islands have been seriously proposed and it can be assumed that most major technical problems are capable of solution.

The New Jersey Public Service Company is currently developing a floating nuclear unit to be located three miles off the Jersey coast. This is an important case situation to monitor for feasibility and acceptability in Long Island Sound. Almost all land siting deficiences can be overcome by this siting procedure, but aesthetic, water quality, and ecological problems will still require examination.

A more comprehensive and detailed evaluation of alternative energy forms and plant siting options is presented in the planning report *Power and the Environment.*

The potential for *electric power conservation* in the Service Area depends on several factors: (1) cost of electric power, (2) legislative regulation of consumption and wasteful practices, (3) public willingness to conserve, and (4) technological improvements. The price of electricity has increased drastically in the past year and seems almost certain to continue rising at a faster rate in the next ten to fifteen years than it did in the same period up to 1973. Price rises plus petroleum shortages provoked roughly a 10 percent decrease in electric power consumption in some areas, mainly through elimination of some easily corrected wasteful practices. Energy conservation could be just a "one shot deal" if this were the only area of potential energy savings. However, the loss of cheap power is going to force bigger changes in bulk industrial and commercial use, as well as in residential use. The Federal Energy Administration has published conservation goals of up to 30 percent for many industries. Industry many require a few years to modify many of their processes to reduce consumption and achieve some savings if they feel that they cannot pass the increased costs on to consumers. More important in this Service Area, however, are the commercial bulk users. There is less built-in incentive for reducing heating, air conditioning, and lighting in commercial space. Stores and office buildings are naturally afraid of losing business if they subject their customers and tenants to any physical discomfort from such conservation. They would generally prefer to simply pass the added cost on. The conservation savings would be more likely in new buildings, where excesses in lighting, cooling and heating systems could simply be designed out and energy-conserving architecture bullt in. So at least the rate of increase in electric power consumption can be slowed from that used for projections presented earlier.

For residential users, the rate of increase in electric bills, at least in the short-term, is likely to exceed the rate of increase in personal income. This factor, together with increasing electric costs of appliance usage, means that the public is going to buy and use fewer home appliances that had previously been anticipated. In new housing, savings in energy consumption can be achieved by requiring improved FHA insulation and architectural standards for single and multi-family housing, using federal mortgage lending practices to enforce compliance. Further savings can be achieved by practices to enforce compliance. Further savings can be achieved by including efficiency ratings of air conditioners and other major energy-consuming home appliances on their labels.

New processes and technological improvements for energy savings will also be developed as a result of pricing incentives. All of the above savings, though, are basically free market responses. If the federal or state government felt strongly that it is in the overall public interest to achieve even further savings, it could establish mandatory or voluntary programs to achieve this purpose. Mandatory conservation goals for each user group could be established with stiff penalties for failure to achieve adequate reductions in consumption. Voluntary goals with public disclosure of results and/or high penalty charges for consumption rate structures might work, but its overall effect on jobs and the economy is not clear. These are just a few of the possible ways state or federal governments could encourage or enforce future energy conservation.

With regard to which level of government should assume this initiative, if a state believes that federal conservation policies are not tough enough to serve its interests, it should not hesitate to establish bolder policies and programs.

An alternative for future energy generation is *new energy forms.* Scientists and engineers are actively working to develop new technologies and make other known ones feasible for commercial use. However, with lead times for new power plants now eight to twelve years, technologies not available for commercial use by 1980 can probably not be depended upon to meet any of the 1990 needs. None of the technologies listed below are expected to be available before the mid-1980s. Still, in the long term, some of these will probably provide the best hope for a reliable supply of power with minimal effect on environmental values. These potential new energy developments include coal gasification, commercial use of fast breeder reactors, commercial application of magnetohydrodynamics, development of fusion reactor technology, use of solar energy for both space heating and generating electricity, wind power, and fuel cells.

One of the major problems discussed earlier is the effects on aquatic life from thermal wastes. Several *cooling system alternatives* have been weighed for environmental and economic suitability in this region. The U.S. Environmental Protection Agency has developed effluent limitations for thermal waste discharges. The thermal regulations require that all new plants, along with those of 500 megawatts or greater size which went on line after January, 1970, install some form of off-stream cooling device. Under other

regulations, a power plant may apply for a modification to heat limitations if it can demonstrate that its thermal discharge will not damage a "balanced community of shellfish, and wildlife." Other power plants which are exempted by age or size from these regulations must still comply with water quality standards. It seems that with proper siting and expected technological improvements, the thermal effects of once-through cooling can be minimized for plants on the Sound. Minimizing the effects from plants on rivers and lakes will be more difficult. Once-through cooling is the least expensive option and also avoids the aesthetic blight of cooling towers.

In the Service Area, cooling ponds and spray canals are almost universally ruled out because of unavailable land. For example, a closed loop cooling pond for a 1000 MW unit would require about 2,000 acres. A spray canal for the same facility would have to be 320 feet wide by 28,000 feet long if straight, or 160 feet wide and 28,000 feet in total length if U-shaped.

Most of the aesthetic and environmental problems associated with cooling towers were discussed above. They have high capital, operational, and maintenance costs. While there are some benefits to aquatic life for power plants along fresh water streams, the environmental effects from cooling towers on land, air, and visual quality may be undesirable. On Long Island, fresh water mechanical and natural draft towers are not feasible because of their consumptive use of the area's limited drinking water resource. Closed system dry cooling towers are also not economically practical at this time, since they are most costly and inefficient.

A comparison of costs for alternative cooling water systems is shown in Table 2.7-3.

TABLE 2.7-3 Range of Comparative Costs of Cooling Water Systems for Steam-electric Plants in the Long Island Sound Area [1]

Type of System	Fossil-fueled Plant[2]	Nuclear-fueled Plant[2]
Once Through	10–15	15–20
Cooling Ponds	18–27	27–36
Wet Cooling Towers:		
Mechanical Draft–		
River	20–24	30–40
Wells	23–27	34–44
Natural Draft–		
River	24–27	36–42
Wells	28–31	39–45
Dry Cooling Towers:		
Mechanical Draft	36–40	50–60
Natural Draft	40–48	60–70

1. Source: *Power and the Environment Planning Report,* Long Island Regional Study.
2. 1973 date base in $/kW.

The problem of scenic deterioration due to *electric power transmission systems* was discussed earlier. Guidance on design guidelines for overhead transmission systems can be found in the study's separately published *Shoreline Appearance and Design: A Planning Handbook.* The basic choice regarding transmission systems, however, is between overhead and underground lines. Historically, the development of electric power systems has been based on the concept of using high-voltage overhead lines for bulk power transmission. The use of underground cable for this purpose has generally been limited to the short distances in extremely congested areas. The principal reasons for this are: (1) as transmission voltages have risen over the years, the technology for overhead lines has been available, while the technology for underground cables of equivalent capability has generally lagged, and (2) the cost of underground transmission has been and remains, much higher than for equivalent aerial circuits. On the basis of present technology, it is estimated that in suburban areas, underground lines cost on the average about 8.5 times as much as overhead lines at 138,000 volts, and about 15 times as much as 345,000 volts. Because of lower rights-of-way costs in rural areas, the comparable figures are 10 and 19 times as much, respectively, for average conditions. The economic costs would be higher if existing overhead lines were prematurely converted to underground because the undepreciated values of the discarded facilities must be included in the cost. As transmission costs represent between 10 and 20 percent of the costs paid by consumers for electricity, the significance of these increases in the cost of transmission can be readily understood.

Underground lines have the further disadvantage of poor accessibility. According to the Advisory Committee on Underground Transmission in its 1966 report to the Federal Power Commission, overhead lines have more outages than underground per unit of length, but the outages are usually shorter in duration. Because of the longer repair time for underground systems, expensive duplicate facilities are sometimes installed to reduce the risk of overlapping outages. Overhead lines have greater flexibility because connections and repairs are relatively simple, and they can be converted to higher voltage if necessary. Underground systems cannot easily be altered.

These disadvantages of underground transmission lines must be compared with the scenic benefits gained. It seems clear that these benefits are not great enough to warrant an end to all overhead lines, present and future. But where unique scenic values would be destroyed, extreme visual disharmony would or has resulted, or cost differences can be shown to be relatively modest, transmission lines should be undergrounded.

Evaluation of alternative plans

The *economic development plan* would favor power plant sites with the potential for lowest cost and most efficient

utility operation. Since the Service Area, and the study area in particular, is well endowed with cooling water resources that would make possible the economical siting of far more steam power plants than we have at present, the economic development plan calls for the Service Area to become a net exporter of power to the larger Market Area. In such a plan the water and related land resources of the Service Area would be somewhat restricted to uses other than for generating power. Thermal loading of water bodies would be permitted. A degree of contamination of air and water discharges would be allowed. Transmission needs would take precedence over aesthetic impact.

On the other hand, in the *environmental quality plan*, the economic goals would be replaced by environmental safeguards that would cause it to be more economical for the Service Area to become a net importer of power from the larger Market Area. Environmental quality would be best served by a power supply system that would place the fewest demands on the resources of the area. However, such an emphasis on environmental quality would reduce the reliability of electric service, reduce efficiency of operation, and create high costs and higher impact on adjacent areas.

Recommended plan

The recommended plan is a composite plan which requires the Service Area to supply 45-50 percent of the Market Area's needs. This plan emphasizes energy conservation, reliance on conventional nuclear power generation to supply most new needs through 1990, increased state responsibility to guide conservation and carry out research and development programs, and increased recreational access to the water at future power plant sites. There is no fuel available today for major electric generating stations that provides inexpensive and reliable power without some possible serious environmental or social impacts. From the point of view, then, of economics, security, and environmental protection, until new and more acceptable energy sources are available, highest priority should be given to conservation of energy. Meanwhile, regulations under such statutes as Article 7 (the "electric transmission law") and Article 8 (the "power plant siting law") of the New York Public Service Law, should be vigorously enforced.

The recommended plan is summarized in the eleven-point program below:

1. **Energy conservation.** New York Public Service Commission and Connecticut State Energy Office, in cooperation with the Federal Energy Administration, should establish state electric energy conservation goals and recommend programs to achieve them. The success of the program will depend in large part on public awareness and willingness to conserve energy. Large savings can occur through:
   a. Mandatory increases in insulation requirements and architectural standards in all new homes.
   b. Mandatory reductions in cooling and heating levels in all public and commercial buidlings.
   c. Mandatory reductions in lighting levels in public, commercial, and institutional buildings, and on highways.
   d. Mandatory reductions in display lighting on bridges, public buildings, supermarkets, and outdoor advertising.
   e. Labeling and taxing low efficiency, high energy use devices, such as air conditioners, heaters, and freezers.
   f. Use of waste heat in the design and operation of all new public buildings.
   g. Incentives to industry to reexamine production techniques.
   h. Utilization of refuse as fuel in power plants and large industrial complexes.
   i. Reduction of peak-hour use through a larger price differential between peak and off-peak use rates.
2. **Energy resource conservation.** State electric energy conservation programs should be carried out in concert with, and consistent with, other energy resources conservation, particularly oil and gas. Neither can be at the expense of the other.
3. **Share of total capacity.** The Long Island Sound Study area should continue to provide 30-35 percent of the Service Area's total future generating capacity.
4. **Reliance on nuclear energy.** The study acknowledges the continuing public concern relative to the safety of nuclear power plant operations, fuel transfer, and disposal. This raises serious questions about the present and future hazard or safety of nuclear generating plants. These problems and their solution, however, go well beyond the scope of this study and are, in fact, the subjects of extensive research not yet completed. Assuming a satisfactory resolution of these problems, the study recommends that the utilities provide all or most of the base load additions in the Service Area with nuclear power facilities, until 1990 or until suitable new forms of energy production become available.
5. **Recreation at generating sites.** For all proposed new generating units along the Sound or other water body, the Connecticut Power Facilities Evaluation Council and the New York Public Service Commission should require the utility to provide recreation and public access to the water.
6. **Research and development programs.** The two state energy offices should suggest to the utilities what percentage of their total resources should be used for research and development and suggest some priorities. In addition, they should carry out studies to determine the socioeconomic impact and burdens of present rates, the price elasticity of power demand, the possible effects of restructuring the rate system, and other measures for the more equitable distribution of costs.
7. **Design standards for future power plants.** The state

coastal zone management programs, in conjunction with the Connecticut Power Facilities Evaluation Council and New York Public Service Commission, should adopt mandatory site selection, site planning, and design criteria for all new power plants in or affecting the coastal zone. *Shoreline Appearance and Design: A Planning Handbook* prepared by this study will provide useful guidance. All such state standards for nuclear power plant siting and design must, of course, be compatible with standards established by the Federal Nuclear Regulatory Commission and requirements of other federal agencies.

8. **Fund for undergrounding selected existing transmission lines.** New York and Connecticut should establish a program for undergrounding selected existing overhead transmission lines in concert with urban renewal programs.
9. **Tax incentives for energy conversion.** Congress and the Legislatures of both states should encourage the development and utilization of new electric energy forms by establishing income tax deductions to offset a portion of the capital costs of installing energy converters other than fossil fuel or nuclear. This should help encourage investment into creative research and provide greater market security for companies considering investing in production facilities for these products.
10. **One-stop licensing.** An inter-agency mechanism, which would include the Power Facilities Evaluation Council in Connecticut and Public Service Commission in New York, should be established to act with finality, subject to due process, on power plant siting. It should operate a unified one-step procedure for federal and state licensing requirements. In addition, administrative procedures should be substituted for the initial adversary process in the courts, which often requires too much time, while proving inadequate to cope with the complexities of the engineering and ecological problems involved. These steps will hopefully shorten the lead time for new generating facilities by several years on the average.
11. **Research on effects of once-through cooling.** Until the cumulative effects of impingement, entrainment, and thermal additions on the Sound's ecosystem are thoroughly understood, all levels of government should continue to support and encourage research and additional study of the effects of the intake and discharge of cooling waters on the Sound.

Commercial Fishing

Background and problems

The overall trend for commercial landings in Long Island Sound has been one of decline since the mid-1950s. The landings of oysters, historically one of the most important commercial species in the Sound, have increased slightly in recent years, but do not approach the landings of twenty to thirty years ago.

Lobster landings increased significantly from 1965, but have decreased since 1970. The increase in lobster landings from 1965 to 1970 can be attributed to an increase in lobster-fishing effort throughout the entire Sound, particularly in western Long Island Sound, and possibly also to a general lowering of coastal water temperatures, which has extended the southern range of the lobster and increased inshore pot catches. The reasons for the decline in lobster landings since 1970 are not completely understood. It may be due to overfishing of the resource or to natural fluctuations of the lobster population.

The landings of commercial finfish species in the Sound have declined steadily in the last twenty to thirty years. The combined 1969 otter trawl landings of scup, winter flounder, bluefish, striped bass, and unclassified bait species amounted to only 1.3 million pounds. Of this total, scup represented 235,000 pounds, yet previous landings of scup in N.Y. waters of the Sound alone have been as high as 1.2 million pounds (1955). Causes for the decline in finfish landings have been attributed to regulations prohibiting commercial fishing in certain portions of the Sound, to declining finfishing effort and, perhaps, to declining and naturally fluctuating fishery stocks.

It has been estimated that the regional demand for finfish and shellfish products is approximately 96 million pounds.[1] While the Sound cannot satisfy the overall demand for finfish products (which includes a demand for non-resident species, such as salmon and tuna), the local demand for shellfish products could be satisfied provided proper management programs were initiated. Oysters and hard clams provide a greater potential than finfish for management because they are endemic, sedentary marine resources which the states could manage on a unilateral basis. Oysters may offer the greatest potential for management, because they are abundant in the Sound, the industry is well established, and oysters can be grown using intensive aquaculture methods.

Oysters. The history of the oyster industry in the Sound has been one of extreme decline. During the late nineteenth century, about one thousand men on 450 vessels harvested approximately 22.5 million pounds of oysters worth an estimated $10 million. Then the industry declined. During the 1930s, Connecticut's oystermen harvested five million pounds of oysters annually. The industry hit bottom in the late 1960s. In 1967, only about 150,000 pounds of oyster meats were harvested from all of Long Island Sound. The low harvests were due to: (1) poor natural supplies of seed oysters, (2) poor natural set, (3) high level of predation by starfish and oyster drills, (4) pollution, particularly toxic industrial wastes and pesticides and herbicides which killed the oyster larvae, (5) lack of clean shells for cultch, which the oyster larvae need in order to set and grow to maturity, (6) damages to productive seed beds caused by storms, and (7) increased siltation in oyster beds, which smothered the oysters. Careless oystering practices, principally poor preparation of seed beds and inadequate management of seed, have also contributed to the industry's decline. During this period of decline, (1960s) governmental and private support for the oyster industry was not sufficient to reverse the trend.

Since its economic low point in the late 1960s, the oyster harvest has again increased. In 1970, oyster production along the Connecticut coast had increased tenfold. The 1970 landings of oysters for the Sound as a whole had a landed value of $641,700, still small, but encouraging. The landings are now estimated to be worth $5 million a year (landed value), and continue to increase in both volume and value.

The rebirth of the oyster industry may be attributed to: (1) effective predator control using applications of quick-

[1] Based on a regional population figure of six million multiplied by a regional fishery products consumption figure of 16 lbs. per person per year.

lime, (2) moving seed oysters away from heavily silted areas early in the year before warming water temperatures stimulate pumping activity, and (3) growing seed oysters in hatcheries to either supplement, or entirely take the place of, fluctuating natural sets.

The major problem facing the oyster industry in Long Island Sound, then, is not declining production. The real problem, rather, is to ensure that the Sound's oyster growing potential (optimum sustained yield) is realized to its fullest. It is not known what this potential is. Perhaps the harvest must forever remain less than the peak years of the nineteenth century because of irreplacable losses of natural oyster habitat. Or perhaps the potential is actually greater than the nineteenth century levels, because improved methods of aquaculture will permit greatly expanded production per acre. It is estimated that intensive management of oyster beds could result in a five to tenfold increase in oyster production over that associated with natural conditions.[2] Although the present harvest could be increased many times over, the problem of market demand must also be considered. Increasing supply will be to no avail if the demand for oysters is not high enough to justify increased production.

One prerequisite to increasing production is to bring more shellfish-producing bottom under management. In the past, shellfish beds have been managed by the commercial oyster growers. The oyster industry, unlike other fisheries, is an example of a type of aquaculture. Like the upland farmer, the oysterman protects his crop from predators and plants seed (spat) from season to season. The oysterman also plows his beds, thereby burying oyster drills and recycling nutrients for a short period for use by algae, which are in turn consumed by the shellfish. In comparison, recreational shellfishermen or public commercial shellfishermen (baymen), lacking the equipment and the incentive to do more than just take oysters, can often pick a bed clean if their activities are not strictly controlled.

No private commercial oyster man will go to the trouble and expense of managing oyster beds if he lacks assurance that he can later reap the fruits of his efforts. Therefore, private oystermen lease shellfish beds from the state or from the towns, whichever has jurisdiction over the bottom. The breakdown of town shellfish beds, including oyster and clam beds, is as follows:

Long Island Sound Town Shellfish Beds

Town Acres	Town Acres Leased	Percent
20,000 (24 towns)	2,405	12
60,200 (Oyster Bay & Huntington	4,271	8

[2] *Aquaculture in New England.* University of Rhode Island Marine Technical Report, Series No. 18.

Shellfish-producing bottoms which are not leased are open to public shellfishing. However, about 90,000 acres of Long Island Sound's total shellfish-producing bottom have been closed by the states for health reasons, except for commercial transplants to clean waters. Water quality problems will be discussed below.

Underutilization of shellfish bottoms often occurs when unleased, but polluted, town-controlled bottoms are effectively closed to the private commercial oysterman by the town's imposition of arbitrarily low bushel and peck harvest limits. Thus, the private commercial oysterman cannot transplant the oysters from polluted water to clean water, a process which could result in the utilization of a presently wasted potential resource and a higher production from the beds.

Although the leasing system has generally worked well, there are some instances involving town-controlled bottom where the oysterman is not assured that his investment on his beds is secure, because of changing town regulations regarding continuing private control of the beds. As a result, the oysterman may stop managing those beds.

A potential problem affecting the full use of shellfish-producing bottom is the failure to actively cultivate portions of leased land, in terms of planting seed, monitoring, predator control, and harvesting. It is likely that lease holders will manage their bottoms as the oyster industry continues to expand. Presently, however, there is nothing to prevent a lease holder from neglecting his leased bottoms, while at the same time keeping people who are willing and able to manage them from doing so.

An alternative to increasing the amount of managed bottom in order to increase shellfish production is to increase the yield per acre, by employing more intensive forms of aquaculture. Many promising experiments are underway right now. For instance, the heated effluent from power plants has been used to expand the growing season and to speed the growth of the oysters. The use of underwater rafts is also being investigated. Benefits of such raft culture include greater oyster production per unit area and reduced incidence of parasitism. Underwater rafts, as compared with surface rafts, are less likely to interfere with boating. However, labor and equipment costs are high. Another promising aquaculture method for combining shellfish culture with the treatment of sewage is being developed at Wood's Hole, Massachusetts. The secondary sewage is used to grow algae, which is then fed to the shellfish, leaving the effluent waters clean and nutrient-free. The shellfish must be allowed to cleanse themselves before they can be consumed. However, retention of heavy metals by the shellfish is a problem that remains to be solved. All of these intensive forms of aquaculture require considerable space. It is possible that by the time these new approaches prove themselves economically, the necessary land and water might no longer be available.

The problem of water quality is most severe for the recreational shellfisherman, who is barred from taking shellfish from polluted waters because of possible con-

tamination by disease-causing organisms. Some commercial oystermen have the equipment to enable them to transplant shellfish from contaminated waters to clean waters. After a period in the clean water at a temperature of 10°C (50°F) or above, the shellfish are considered to be safe to eat. Although it represents another costly step to the oysterman, transplanting is widely practiced and is apparently economically feasible. Thus, water quality, provided it does not deteriorate below its present levels, may not be considered a serious deterrent to the expansion of the oyster industry, provided seed production, either in hatcheries or on natural beds, is assured. Research should be continued, however, to determine whether clams and oysters which are removed from contaminated areas to clean environments do purge themselves entirely of contaminating pathogenic microorganisms. (See Section 2.1 Water Management.)

Clams and other shellfish. The commercial harvest of hard clams has also fluctuated substantially in recent years. The reasons, as with the oyster industry, have been a combination of manmade and natural factors. In addition, over-exploitation of unmanaged beds by small commercial operators and recreational shellfishermen has been a problem.

As with the oyster industry, good management techniques could greatly increase the harvest of hard clams in Long Island Sound. Although the same general precepts apply, the different life cycle of this species requires different aquaculture techniques. Management practices for the hard clam are less developed than for the oyster, because these shellfish are not particularly abundant in the Sound and have, in the past, brought a comparatively low price. Their landed value is increasing, however, and this trend can be expected to encourage development of more efficient culture methods.

Scallop and soft clam fisheries in the Sound and its contiguous bays have also declined to the point of little commercial importance, possibly because of natural fluctuation. New York State's Department of Environmental Conservation is currently engaged in a bay scallop rehabilitation program, in which scallops are collected at Orient and transplanted into Mt. Sinai Harbor, Northport Harbor, Cold Spring Harbor, and a pond at Caumsett State Park. In the past, scallops were present in harvestable numbers in these locations, and it is felt that these areas may once again become productive after being stocked.

Commercial landings of blue mussels and conch, while very small in comparison with oysters and hard clams, have been increasing during the past several years. There is evidence that this resource is abundant, but little is harvested because of a lack of demand and a low return. Both conch and mussels, though, are valued in other parts of the world. In Europe, mussels are cultured intensively.

Lobsters. The growth of the lobster industry in Long Island Sound is recent years has been phenomenal. However, it is felt that the potential for expansion here is more limited than with oysters and clams.

In Connecticut, the lobster catch increased from 207,000 pounds to 800,000 pounds during the years 1958 to 1969. A similar trend has taken place in New York, where the landings have risen from a mere 7,500 pounds in 1958, representing 3 percent of the total landings of lobsters in the Sound, to 330,000 pounds in 1970, or 33 percent of the lobster landings. The increase was probably due to increased fishing effort, possibly related to increases in pot catches brought about by a southward shift in the distribution of lobsters, due to lower coastal water temperatures. The total 1970 Sound landings of lobsters were valued at over $1 million (landed value). However, the lobster resource may be overfished, a situation which has been reflected in the recent decline in the lobster catch since 1970.

In 1972, the American Lobster Subcouncil, composed of state fishery administrators and the Regional Director of National Marine Fisheries Service, was established to provide overall program guidance and to facilitate implementation of decisions on lobster management through existing legal and institutional channels. Also, the Lobster Scientific Committee, consisting of scientists from each state and from National Marine Fisheries Service, was set up to formulate lobster management plans and to coordinate program operations. The Scientific Committee is responsible for recommending to the Subcouncil those practices considered necessary for the efficient and rational management of lobsters. Coastwide lobster management precepts enacted in August, 1972, included proposals regarding the control of total fishing effort on the resource, law enforcement, minimum legal carapace length, maximum size limit, possession of egg-bearing lobsters, the notching of female lobsters, use of escape vents on lobster traps, and licensing.

At the present time, the New York State Department of Environmental Conservation is conducting a study of the age at sexual maturity of lobsters in Long Island Sound, funded partially with federal funds. Also, New York Ocean Science Laboratory (NYOSL) is working on a study of the distribution, abundance, and size-frequency of pre-recruit lobsters in Long Island Sound. The New York State Department of Environmental Conservation is subcontracting this work to NYOSL, using federal funds.

Finfish. For most species, commercial finfishing on the Sound has been declining. The principal commercial finfish species are menhaden, winter flounder, scup, shad, striped bass, bluefish, and Atlantic mackerel. Biologically based management programs could perhaps increase the commercial harvest of these finfish. However, management of migratory finfish species must be accomplished on an interstate basis. Although it may be possible to increase commercial harvests, it might be socially and politically too difficult to overcome the objections of the sport fisherman to such increased harvests.

As of 1972, there were only four full-time commercial otter trawlers in Connecticut waters, landing about 650,000 pounds of scup, winter flounder, and unclassified bait

species. In New York waters, fifteen seasonal otter trawlers operating in 1969 also caught about 650,000 pounds of fish, of which the three top species were butterfish, fluke (summer flounder), and scup. Despite the general decline in finfish landings, several smaller fisheries have remained stable. The pound net fishery on the north shore of Long Island consistently contributes 300,000 to 500,000 pounds of fish to the total commercial catch. The American shad fishery catch on the Connecticut River amounted to 173,000 pounds in 1970. Several small fisheries, such as the eel fishery, have even increased during the 1956-1970 period.

The recent menhaden fishery began on a large scale in the early 1940s. Landings in Long Island Sound fluctuated for a number of years, but have decreased significantly since the mid-1960s. Despite the decline in landings, there is little doubt that the actual menhaden catch for the Sound has increased in the past several years. Landing statistics for New Jersey to Rhode Island inclusive show landings of menhaden increased from 40.6 million pounds in 1970 to 172.6 million pounds in 1973. It is likely that a large proportion of these landings were caught in Long Island Sound.

The overall decline in the commercial catch of finfish can, in part, be attributed to a decline in commercial harvesting effort, due to regulations discriminating against the commercial fisherman in favor of the sport fisherman. Regulations prohibiting gill netting, purse-seining, and otter trawling in western portions of the Sound relate to the controversy between sport and commercial fishermen concerning bluefish, striped bass, and menhaden catches. Unfortunately, some of these regulations, enacted on the basis of emotion rather than fact, may have no biological basis. In addition, deterioration of habitat, such as wetlands, may have reduced finfish populations, although presently there is no quantitative data to support this theory. Also, water quality in the Sound has declined, perhaps contributing to reductions in fishery stocks.

Evaluation of alternative measures

The objectives for commercial fishing are to increase production of fisheries products in Long Island Sound through proper management programs, while recognizing the Sound's importance for recreational fishing.

Shellfish management/research program. Of primary importance to shellfish management is a comprehensive survey of the Sound's shellfish beds by the states. Such a survey would include updated information on the size and productivity of the beds and would also include comprehensive collection and tabulation of data on the number of acres of state-owned, town-owned, and privately-owned (leased or franchised) beds. This information is very difficult to determine at the present time, particularly for the Connecticut waters of the Sound. Once these data are obtained, further research sponsored by federal, state, and local funding would include investigation into the size of certain shellfish species at sexual maturity, conditions affecting sets, and possible predictions of sets. A comprehensive survey of the harvest of shellfish from public and private beds is also needed.

A consideration of primary importance for effective management is enforcement of management regulations. Without adequate surveilance and strict enforcement, a management program cannot be successful. Of course, to be successfully enforced, such regulations must be practical. Potential management objectives based on the above information would include a flexible shellfish quota system based on reliable harvest statistics, and efforts to establish uniform size limits, leasing regulations, and license requirements throughout the Sound.

In addition to these management objectives, research institutions could strengthen their programs for improving the genetics of oysters, to develop shellfish stocks that are faster-growing, more disease-resistant, and thicker-shelled to reduce predation by oyster drills. Further research into control of oyster diseases and natural control of predators is also important. In particular, the laboratories of the National Oceanic and Atmospheric Administration in Milford, Connecticut, are well situated to work closely with local governmental and private groups, to disseminate information about improved oyster culture methods.

Establishment and expansion of port landing facilities. Upgraded or new facilities would increase local Sound catches, many of which are now landed outside the Sound area. Such measures would make fresh fish available to local markets, reduce wear and tear on boats and equipment, and reduce fishermen's operating expenses. Minor environmental and social disadvantages associated with the construction of landing facilities and increased boat traffic are foreseen. The costs of such facilities may be prohibitive in terms of the return, however.

Commercial fishing assistance programs. The commercial fishermen could receive assistance, indirectly through the results of research, and directly through tax exemptions and equipment loans. Loans could be financed through the Federal Fishing Vessel Mortgage and Loan Insurance Act, or possibly through FHA. The commercial finfishery could also benefit through the reevaluation and possible revocation of certain commercial fishing regulations that may have no biological basis. Present commercial fishing prohibitions include: (1) Connecticut's law prohibiting commercial fishing for striped bass, (2) prohibition of otter-trawling and menhaden purse-seining in the western end of the Sound, and (3) the prohibition against gill netting. Some economic problems are foreseen in obtaining financial assistance for commercial fishermen. The major problems involved in reevaluating the laws governing the commercial fisherman are legal and socio-political.

Assurance that the combined impact of sport and commercial fishing will not jeopardize resident and migratory finfish species could be achieved through appropriate management/research programs for these species. Habitat

preservation, including wetland preservation and restoration and improvement of water quality, is of primary importance to management of these fisheries. Resolving conflicts between commercial and sportfishermen regarding the catch of certain finfish species would be an important step towards efficient and effective finfish management. Public environmental education programs could help to reduce such conflicts, through dissemination of facts based on biological findings. Environmental education programs would also serve to acquaint the public with the inherent value of the Sound's marine and upland wildlife resources. (See Section 2.4 Sport Fisheries and Wildlife.)

Evaluation of Alternative Plans

Two alternative plans are considered, the first emphasizing Environmental Quality, the second emphasizing Economic Development.

An Environmental Quality (EQ) Plan would favor only those objectives that would benefit the Sound's ecosystem. Such a plan would include all the above measures except expanding the shellfish industry (although an expanded but well-managed shellfish industry would probably not be environmentally detrimental and could profit from improved water quality), establishing port landing facilities, reevaluating commercial fishing regulations, and providing assistance to the commercial fisherman. The benefits of an EQ plan are considerable to the commercial fishery, however, and a well-managed commercial and sport fishery would have no major adverse effects on the Sound's natural ecosystems.

An Economic Development Plan (ED) would recognize Long Island Sound's potential for becoming a major producer of shellfish products, and would favor those measures that would enhance the opportunities for expanding the shellfish industry.

In addition, an ED plan would support those measures that would improve commercial fishing. Such a program would favor all the measures except those calling for assistance programs for non-shellfish commercial fishermen, which rated only fair.

Recommended Plan

1. **Strengthen existing shellfish management/research programs.** The states, towns, and local research institutions should make every effort to encourage an expanding shellfish industry by bringing existing shellfish beds under proper commercial management.

Priority should also be assigned to a comprehensive survey of the Sound's shellfish beds in regard to monitoring the abundance and condition of the stock. Management objectives should include the strengthening of shellfish-related research programs and measures which promote uniform shellfish regulations in regard to leases, license sales, and size limits. In addition, such regulations must be backed by adequate surveillance and strict enforcement.

a. Towns should encourage commercial fishermen to manage the shellfish beds under town jurisdiction by making uniform long-term leases for deep water oyster beds available to the private commercial oystermen, and replacing arbitrary bushel and peck limits in town waters with new limits designed to maintain optimum sustained yield.

b. Connecticut's Aquaculture Division of the Department of Agriculture and the New York State Department of Environmental Conservation should be responsible for comprehensive monitoring of all shellfish beds in the public domain, including those under local jurisdiction, to determine productivity (set success), conditions affecting set, and effects of harvesting pressure. Flexible quota systems and size limit regulations, based on reliable harvest data and backed by effective enforcement, could help to prevent overfishing of the beds.

c. The states, in cooperation with local research institutions and NOAA's Milford Laboratories, should explore the possibilities of more intensive aquaculture methods, such as submerged raft culture and pond culture. Research programs in oyster genetics, oyster diseases, methods of natural control of predators, and reasons for variations of natural sets should also be strengthened. In addition, NOAA's Milford Laboratories should continue their contacts with local and state agencies and private interests to disseminate information on improved methods of oyster culture.

d. The states and towns should adopt mechanisms for revoking the shellfish leases when the leased bottom is not being used. A leased area could be opened for bids if it has not been managed for a stated period of time as set by state and local authorities.

e. As a medium range goal, the states, in cooperation with the towns, should continue to identify those areas which formerly produced shellfish and no longer do so. These do not include areas uncertified and closed for health reasons. Where feasible, the towns and states should take steps to restore these areas to their former productivity. In those areas of the Sound that are not naturally ideal for oyster production, the states should promote aquaculture methods for the management of hard clams and scallops.

f. Connecticut's Aquaculture Division, in cooperation with local universities, should find a candidate town and initiate a pilot project of growing shellfish with sewage wastes as a part of that town's sewage treatment system. The project would have the dual goal of helping to solve the technical and economic problems of sewage treatment, and would also heighten public awareness of such a recycling system.

g. The states should identify those areas along the coast where a relatively small modification in the way sewage is handled would result in compliance with the health code and possible re-opening of shellfish beds for recrea-

tional harvest. In addition, new criteria for closing shellfish beds, other than the total coliform standard should be adopted. As a start in this direction, it should be noted that the Food and Drug Administration recently approved a second optional criterion, utilizing the fecal coliform organism, in lieu of the total coliform standard, for classifying shellfish growing areas.

2. **Improve water quality**. The ongoing cleanup of pollution in the Sound should be further encouraged. It should be noted, however, that improvements in water quality in the forseeable future would probably not result in the opening of any substantial portion of the presently uncertified shellfish beds. (See Section 2.1 Water Management.)

Additional programs relating to commercial fishing and sportsfishing are described in Section 2.4 Sport Fisheries and Wildlife.

Mineral Resources and Mining

Sand, gravel, and stone are the only mineral commodities mined in substantial quantities in the study area. Long Island is the source of more than two-thirds of the sand and gravel produced in the area, while Connecticut provides less than one-third, but virtually all of the stone, most of which is crushed to become aggregate.

These materials are essential ingredients in residential, commercial, industrial, and highway construction, accounting for between 4 and 13 percent of construction costs. While the unit cost of these materials is low at the source of production, it rises rapidly as the distance to the construction site increases. For example, if the price of sand, gravel, or crushed stone is $1.25 a ton, f.o.b. plant, the cost will double about every 8-10 truck miles, 50 railroad miles, or 125 barge miles. Consequently, deposits close to centers of building activity have been the first to be used. Thus Nassau County—because of its proximity to New York City—has been the source of as much sand and gravel production as the rest of the study area combined.

Transportation over longer distances is generally accomplished by barge. Sand and gravel is the second largest commodity, after petroleum products, shipped on Long Island Sound. Truck transport is most common for short hauls, while rail is the least utilized transport mode.

The problem: abundant supplies, diminishing availability

Since no adequate substitute materials are likely to be developed in the foreseeable future, construction in the region will continue to be dependent on supplies of sand, gravel, and stone, either from within the study area or imported from sources outside the region. Ironically, while the deposits of these materials are abundant around the Sound—as well as, in the case of sand and gravel, beneath its water—their availability is diminishing rapidly. Figures 2.9-1 and 2.9-2 show the general locations of minerals resources around and beneath the Sound. The diminishing availability of these resources is caused primarily by the increasing preemption of mineral lands by other land uses and the bad neighbor reputation of mining operations. Sand and gravel deposits often make good sites for residential and commercial developments or are underlain with and protected as potential water supplies. Sewer and underground cable installations, highways, and even cemeteries are located on these deposits for ease of digging.

Noise, dust, heavy truck traffic, scarred lands, sedimentation from the operation, and abandoned barges and other equipment have combined to make mining unpopular and unwanted as a neighbor. Most towns in the study area now have extensive regulations controlling mining operations. Some are so restrictive, however, that mining is uneconomical. Although local zoning laws allow it, no new sand and gravel operations have started up in Nassau County in the past ten years.

The result of this paradox of abundant supply and diminishing availability is steeply rising prices, as the demand gradually increases and transportation distances lengthen. This in turn helps to push the cost of construction even higher. Table 2.9-1 shows the demand for these materials, the available resources, and the deficit (needs) by subregion in 1970, 1990, and 2020, and highlights the severity of the problem, especially in the western portions of the study area.

What can be done to meet the region's needs for sand, gravel and stone

With the objective of meeting the region's need for construction mineral commodities in economically, environmentally, and socially acceptable ways, the study considered five alternative approaches:

1. Sequential land use.
2. Mining beneath the waters of the Sound.
3. Manufacturing sand from stone.
4. Importing materials from outside the region.
5. Modifying construction specifications so that varieties and hence quantities of materials could be utilized.

Substitution of other materials, reducing demand and not meeting the need were not considered to be viable

FIGURE 2.9-1 Major Sand & Gravel Resources in the Area Surrounding Long Island Sound

FIGURE 2.9-2 Generalized Distribution of Sediment in Long Island Sound

The percentages are the proportion of sand and gravel to total sediment. For example, the 75-89 percent zone includes 11-25 percent of silt and clays. The locations of the "sand waves" are taken from a figure in volume 81, number 3, March, 1970, publication of the *Geological Society of America Bulletin,* entitled "Sub-bottom Study of Long Island Sound," by M.S. Grim, C.L. Drake and J.R. Heitzler.

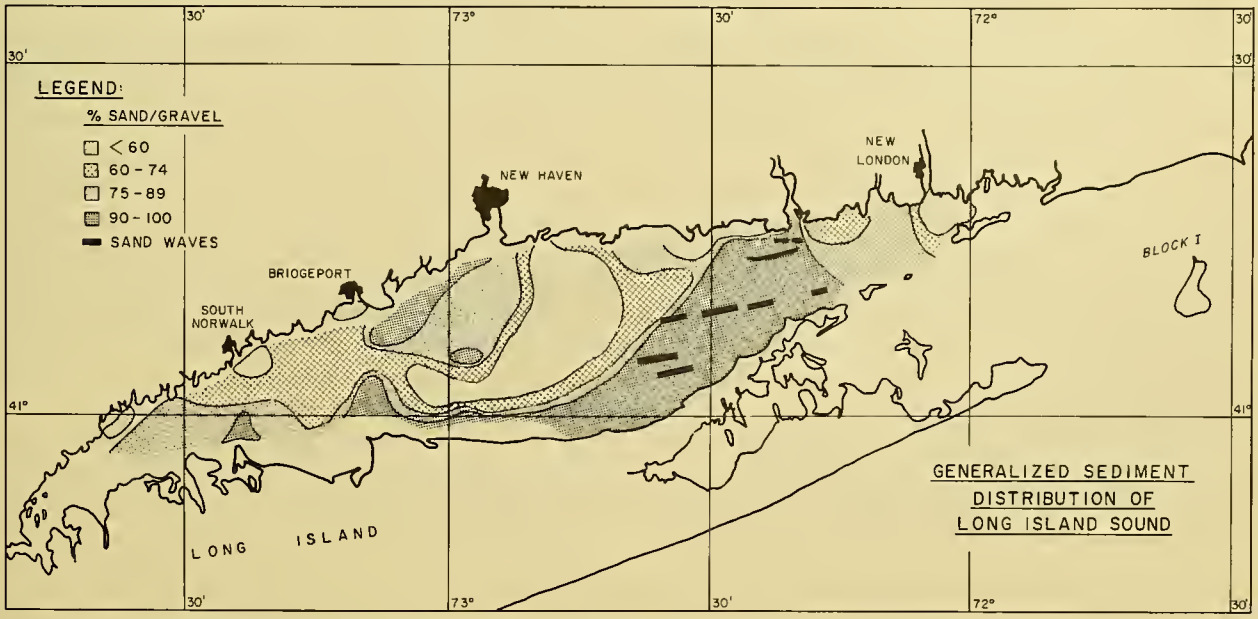


TABLE 2.9-1 Demand, Capability, and Needs by Subregion

SUBREGION	Commodity	Demand[1]			Capability		Needs[2]		Land Requirements[5]	
		1970	1970–1990	1970–2020	Total Resource[3]	Available Resource[4]	1970–1990	1970–2020	1970–1990	1970–2020
		(million tons)	Cumulative Total (million tons)		(million tons)		Cumulative Total (million tons)		Cumulative Total Acres	
1*	Sand & Gravel	0.5	10.8	30.6	593.0	396.9	0	0	0	170
	Stone	0.2	3.9	11.2	Total resources are extensive; availability has not been determined. Resources are granite-type rocks, not traprock. Existing quarry locations and facilities outside the Subregion satisfy demand.					
2	Sand & Gravel	0.1	2.8	8.9	117.2	81.7	0	0	0	50
	Stone	0.05	1.0	3.3	Total resources are extensive; availability has not been determined. Resources are granite-type rocks, not traprock. Existing quarry locations and facilities outside the Subregion satisfy demand.					
3	Sand & Gravel	1.1	24.5	68.2	88.6	54.5	0	13.7	430	1320
	Stone	0.4	9.0	25.0	Total resources are extensive; availability has not been determined. Resources are granite-type rocks and traprock. This Subregion exports a great quantity of traprock to other parts of LIS.					
4	Sand & Gravel	0.8	18.8	53.0	23.4	17.6	1.2	35.4	370	1140
	Stone	0.3	6.9	19.4	Availability has not been determined; resources are traprock and granite-type rocks. Existing quarry locations and facilities outside the Subregion satisfy demand.					
5	Sand & Gravel	0.7	16	44.6	4.0	2.0	14	42.6	310	904
	Stone	0.3	5.9	16.3	Total resources are extensive; availability has not been determined. Resources are granite-type rocks, not traprock. Existing quarry locations and facilities outside the Subregion satisfy demand.					
6a Westchester	Sand & Gravel	0.8	16.7	41.4	Unknown	0	16.7	41.4	Subregion demand is satisfied solely through imports.	
	Stone	0.3	6.1	15.1	Unknown	0	6.1	15.1		
6b Bronx & Queens	Sand & Gravel & Stone	4.4	97.1	150.9[6]	Demand in these counties is satisfied solely through imports from Connecticut, New York, and New Jersey.					
6c Nassau	Sand & Gravel	3.1	67.6	180.1	Extensive	15-30[4]	38-53	151-166	Acreage requirements cannot be determined until resource areas are mapped.	
	Stone	1.1	24.7	65.9	0	0	24.7	65.9	Stone is imported.	
7-8-9 Suffolk	Sand & Gravel	2.4	71.4	252.8	Extensive	91-106[4]	0	147-162	Acreage requirements cannot be determined until resource areas are mapped.	
	Stone	0.9	26.1	92.5	0	0	26.1	92.5	Stone is imported.	

1. For Subregions 1, 2, 3, 4, 5, and 6a, demand for sand and gravel is based on a 7-year average of apparent per capita consumption, (2.16 tons), and town population projections. Demand for stone is based on a 3-year average of apparent per capita consumption, (.79 tons), and town population projections. Demand in Subregions 6c, 7, 8, and 9 is for total counties using the same methodology. Demand for sand, gravel, and stone in Subregion 6b (total counties) is based on a 4-year average of per capita consumption (1.28 tons), determined from imports of sand, gravel, and stone reported by the Corps of Engineers in "Waterborne Commerce in the United States." Does not include imports by truck or rail. Ad Hoc Population Projections for Bronx and Queens were provided by BEA for the years 1970-2000.
2. Difference between available resources and demand.
3. Data source: Connecticut Department of Transportation, Bureau of Highways, Soils and Foundations Division, "Construction Aggregate Availability Study: Summary Reports, 1966, 1970, 1972. Refers only to resources above the water table.
4. Interpreted from land use maps—includes sand and gravel deposits on lands mapped as extractive industrial and open (unused) uplands in Connecticut. A rough estimate of available sand and gravel resources on Long Island has been reported to be 121 million tons. This figure has not been verified. Tonnage was distributed in proportion to the number of producers in Nassau and Suffolk Counties.
5. Resource acreage requirements *in addition* to those already classified as in extractive industrial use. Acreage based on an average deposit size in the Connecticut subregions.
6. To the year 2000.

* Denotes subregion with potential for exporting sand and gravel.

alternatives to satisfy a major portion of projected needs. Substitute materials, such as marine muds, although technically feasible, were not considered practical in the quantity sand, gravel, and stone are used for construction. Some small demand reduction might be feasible without serious social or economic disruption. But either a major demand reduction or not meeting the need is believed to have major adverse impacts on the economy and quality of life in the region.

Sequential land use would provide for the extraction of existing mineral deposits *before* the land is put to other, preemptive uses. It recognizes minerals production as a legitimate *interim* use of the land, compatible with other land use recommendations of this study. It is consistent with the study's recommendation to avoid the continuation of urban sprawl by concentrating most new developments in existing settled areas. Furthermore, mined out lands, if properly reclaimed, can provide needed open space, sites for recreational facilities, and even residential and commercial development. Conservation plans for these areas can be developed by Soil and Water Conservation Districts with technical assistance from USDA Soil Conservation Service and the states' Departments of Environmental Protection and Conservation. However, on prime recreational lands, mineral extraction might conflict with the development plan for an area. Special attention would be necessary to safeguard against this possibility. In other areas of the country, producers operating under a sequential land use plan have reported reductions in f.o.b. prices of 25 to 30 percent.

In order to be successful, a policy of sequential land use would require:

(1) Establishment of state standards for local extraction regulations which protect environmental quality, but are not so restrictive as to make extraction clearly uneconomical, and which specify that property containing valuable mineral deposits be designated for non-preemptive uses. Such regulations could not, of course, require that mining operations actually be conducted on privately owned property unless the town or state were willing to purchase the property and pursue the mining activity itself.

(2) Establishment and strict enforcement of uniform regulations for the operation of surface mines, the appearance of operations, the reclamation of lands after mining operations are completed, and the restoration of presently "orphaned" lands from past operations. New York State's recently passed Mined Land Reclamation Law does provide for all but the latter. In Connecticut, the Commissioner of Environmental Protection has the authority to impose similar regulations, but has not yet done so.

Technological developments in recent years have greatly improved the ability of the industry to operate profitably within strict standards of performance. Problems which have contributed to a negative public view of mining operations, heavy truck traffic, load spillage, noise, dust, deflated property values surrounding the site, and blighted landscapes, can and are being reduced. Furthermore, the industry is now aware that in order to keep operating, certain steps need to be taken during the mining operation to protect the environment and that mined lands need to be reclaimed for future use. In fact, reclamation techniques have improved to such an extent that land values have increased as much as ten times their value prior to excavation.[1]

(3) A program of public education to further understanding of both the economic and environmental aspects of mineral extraction, so that a sound and sensible policy could emerge over a span of time as a result of informed public consideration.

Marine mining may offer an alternative to mining operations on land. Although there is presently no mining of sand and gravel deposits beneath the waters of the Sound for commercial purposes, information from private industry shows that the cost of producing a ton of sand and gravel by marine mining methods would run about 10 percent less than present mining methods, such as those practiced in Connecticut, but 15 to 20 percent more than the proposed sequential land use method. Before 1965, seven million tons were mined, principally for construction of the Connecticut Turnpike and a power plant in Bridgeport Harbor. Dredging of sand to replenish certain public beaches takes place from time to time as well. All other removal of materials from the Sound bottom takes place in connection with maintenance or deepening of navigational channels. See Section 2.6 Marine Transportation.

There are, however, some serious problems which must be resolved before such operations could begin. First it must be determined whether there are large enough deposits of sand and gravel of a suitable quality under the Sound to be mined economically and where these deposits are. Preliminary studies indicate their presence, but there is still insufficient data to make reliable estimates of their magnitude.

Recent technological developments in underwater dredging make it possible to mine sand and gravel from the Sound bottom at depths greater than 100 feet, thus increasing the potential for an offshore mining program.

Potentially adverse environmental impacts will require considerable further study. These involve the effects of marine mining operations on the animal life in the Sound, particularly shellfish, the resuspension of bottom sediments which may contain nutrients and heavy metals, the effects of changing the bottom profile on the natural movements of currents and bottom materials, the on-land storage requirements, and the truck traffic which might be generated.

Finally, there are legal and institutional questions to be resolved regarding ownership of underwater mineral deposits, regulation of marine mining operations, and potential conflicts with other uses of the bottom, such as shellfish production.

There appear to be some inevitable and possibly irre-

[1]National Sand and Gravel Association. Case Histories: Rehabilitation of Worked Out Sand and Gravel Deposits. Washington, D.C., May 1961.

versible impacts on the environment when offshore mining is undertaken. Decision makers and their constituents must decide whether the benefits adequately offset these damages. Such decisions can only be made on the basis of further detailed studies of the issues outlined here and in the separately published Mineral Resources and Mining Planning Report.

Manufacturing sand and gravel from crushed stone is increasingly satisfying the demand for construction materials as natural sands and gravels become depleted or unavailable. But to meet all of the region's anticipated needs in this way would require that stone production be at least tripled. It is not known whether available deposits could meet this demand.

Furthermore, the problems facing stone producers are the same as those confronting sand and gravel operators—conflicting land use, adverse public opinion, environmental concerns, and restrictive zoning. Stone mining has unique problems, as well. Long Island, Bronx, Queens, and Westchester do not have available sources, thus necessitating greater transport distances—and costs—to import from other areas. While reclamation of quarried lands is more difficult and final land uses more limited than the reclamation of mined out sand and gravel sites, one possible use for them is as water reservoirs. Manufacturing sand from stone consumes more energy and is less economical than utilizing natural sand, and the "fines" which remain as a residue of stone crushing operations are difficult to dispose of. However new techniques of quarrying and crushing stone, and of disposing of the fines commercially have been developed which both reduce costs and make stone operations more compatible with the environment.

Importing sand and gravel from outside the region offers an attractive alternative in the sense that residents of the study area would no longer be concerned with active mining operations, and disturbances to the land from mining would cease. However, there is no guarantee that other areas would supply these needed materials to this region. Aversion to mining operations is not unique to the people of this region alone. And, of course, costs would rise steeply as shipping distances and handling increased, since transportation is such a large proportion of total delivered price.

Modifying specifications as to the quality of aggregate materials for certain construction purposes would increase the supply of available materials. New York State Bureau of Materials has instigated such action with positive results. It allows utilization of existing deposits which do not meet present standards, either closer to points of consumption or with less processing, thus providing some cost savings. Some specifications, however, cannot be lowered without incurring health and safety risks. Lowering specifications could also cause increases in the use of other materials such as cement, lumber, and steel.

Evaluation of Alternative Plans

Three alternative plans were considered for meeting the region's needs for sand, gravel, and stone, each one utilizing one or more of the measures described above, with varying degrees of emphasis on each.

One plan, emphasizing environmental quality and attempting to eliminate the social nuisance characteristics of mining operations, would rely to a great extent on importing sand, gravel, and stone from outside the region, strict environmental safeguards during extractive and processing operations within the region, and strict reclamation of all mined areas.

From this point of view, mining would be greatly reduced or eliminated in the area. The price of these materials would rise substantially, pushing up construction costs proportionately. The region would be paying the price for not having to put up with the adverse effects of mining.

The problem with this dependence on outside sources is that there is no assurance adequate supplies would be available. Failure to meet the region's needs could possibly deter needed construction projects, which could adversely affect other aspects of the region's environment. Air and water quality, transportation and other public services, recreational facilities, and power generation are all dependent to some degree on the availability of sand, gravel, and stone for construction. Jobs and the region's economy could also be adversely affected.

A second plan, emphasizing economic efficiency and low price, would stress the use of mineral deposits closest to their point of consumption, with little regard for protecting the environment, reclaiming mined-out lands, or regulating operations to reduce their nuisance features, since these things all cost money.

To a large degree, this has been the industry's approach to the problem in the past. But it has not resulted in low prices. Rather, it has caused the public to be hostile to mining operations and indifferent to the dwindling availability of the minerals, with resultant sharply increasing prices.

Recommended plan

A third, and recommended plan, is based on the study's conclusion that mineral resources in the region can be extracted and used for the public's benefit without causing unacceptable environmental damage or being a nuisance to the great majority of the region's people. The plan will hold steady, or reduce, the cost of sand, gravel, and stone at the point of production and provide substantial savings in transportation costs.

Connecticut and New York should each move toward a regional, coordinated minerals policy designed to foster and encourage the development of an economically sound and stable mining and minerals industry, and the orderly development of regional mineral resources to assure satis-

faction of economic needs compatible with sound environmental management practices.

This plan is summarized in the following six-point program:

1. **Sequential land use.** The Commissioner of Environmental Conservation in New York and the Commissioner of Environmental Protection in Connecticut, with assistance from other appropriate state agencies, should establish programs and regulations to foster a policy of sequential land use by local governments, including the following:
   (a) State-wide standards for local mineral extraction regulations;
   (b) Uniform regulations or criteria for mining operations and reclamation of mined lands and a system of mining permits;
   (c) Identification of mineral deposits potentially available for extraction, where this has not already been accomplished (principally on Long Island);
   (d) Technical assistance to municipalities to encourage land use decision-making that will result in the extraction of minerals before the land is preempted for other uses;
   (e) Public education programs to enhance public understanding of both the economic and environmental aspects of mineral extraction and stimulate the development of fair and reasonable mining policies at the local level.

In New York State items (a) and (b) are being developed and mining permits will be required for all operations after April 1, 1975.

2. **Reclamation of Port Washington sand pits.** As part of the Long Island Sound Heritage, the Port Washington sand pits should be acquired and reclaimed as a major new public shorefront facility by 1980. While certain compatible non-recreational uses might be permitted along the western boundary and the interior, the emphasis of the reclamation, particularly near the shore, ought to be the provision of expanded recreational opportunity. The existing town and county parks could either continue to operate within the new park or as part of it. Detailed plans should be developed in concert with the town of North Hempstead and Nassau County.
3. **Study marine mining feasibility.** The U.S. Geological Survey, with the U.S. Army Corps of Engineers, in cooperation with the Connecticut Department of Environmental Protection and New York Department of Environmental Conservation, should conduct a study by 1978 to determine the quality, quantity, and location of sand and gravel deposits within the Sound, and assess the economic, environmental, and legal feasibility of marine mining to meet regional needs.
4. **Review of progress.** New York and Connecticut legislatures, through their committees on Environmental Protection and Conservation, should monitor the progress and effects of the implementation of a minerals policy, to insure that the objectives of meeting the region's mineral needs in environmentally and socially acceptable ways are achieved. If the orderly extraction of minerals does not occur as a result of these policies, then the legislatures should establish a minerals extraction policy and require that lands containing valuable mineral deposits not be used for any other preemptive uses until these deposits have been extracted.
5. **Rail distribution links.** The Departments of Transportation in New York and Connecticut should take steps to insure the preservation of rail transportation links and storage areas necessary to the distribution of minerals from present or future production sites.
6. **Restore abandoned sites.** New York Parks and Recreation Department and Connecticut Parks and Recreation Unit should initiate programs to reclaim selected abandoned mining sites which are especially suited for recreational use with funds provided by the appropriate federal, state, or local government sources.

Flood Damage Reduction

Causes and extent of flooding

Floods have been part of the region's history since before man arrived. They can be caused by hurricanes and extra-tropical storms (tidal floods) or by spring thaws and sudden or prolonged deluges (riverine floods). Hurricanes hit the region about once every ten years, with disastrous hurricane-caused floods expected about once every twenty-five years. Major floods of this type were experienced in 1938 and 1954. Knowing the inevitability of these natural phenomena, one might expect that man would not have built upon the flood plain. But there are several factors which have encouraged development in spite of the hazards.

In New York, the bluffs on the north shore of Long Island have prevented extensive development along much of the shoreline. However, on the mainland, and in Connecticut particularly, settlement took place around "protected" harbors which allowed for movement of commerce and people. These harbors are cities today and their location on funnel-shaped estuaries tends to magnify the storm surge. During a hurricane, the whole surface of the Sound can be raised six to ten feet, with much higher levels reached in the harbors because of wave heights and wave runup. In spite of this threat, however, many people and businesses have demonstrated that the locational advantages are often worth the risk. People's memory spans are also very short, and the trend has been that without regulations to prevent new development, industry, housing, and commerce all return to the flood plain less than ten years after a major flood.

Along the rest of the mainland shoreline, narrow beaches with few dunes make poor buffers. Many of these beach areas are filled with seasonal cottages where the owners are often short-term and think that "a flood won't get them" during their five to ten years of ownership. The seasonal homes are also encouraged by municipalities for their tax support and low municipal service requirements.

So people's reactions to the flood dangers have been disappointing. Only immediately after a flood is there local support for projects to protect existing developed areas. As people's memories falter, costs to the local people and possible environmental damage tend to become the paramount concerns. This has been partly responsible for the repeated rejection of structural solutions proposed by the U.S. Army Corps of Engineers. For tidal flooding, only two projects have been completed (Pawcatuck and Stamford), one is under design (New London) and three have been de-authorized or become inactive. Although non-structural flood plain management solutions tend to be preferred at the state and local level now, their implementation has been slowed until this year, since there was little federal financial assistance available for them. However, Section 73 of the 1974 Water Resources Development Act now authorizes a minimum of 80 percent federal participation for non-structural flood damage reduction measures – about the same share as for structures. This should provide a needed financial incentive for many communities to implement effective flood plain management solutions.

The pattern for riverine flooding and development in the riverine flood plain is basically the same as for the tidal. The major difference is that for the small drainage basins that make up most of the region, the local intense cloudburst is often more damaging than the regionally important great storm that dominates the tidal flooding.

Tidal floods produced by hurricanes and extratropical storms have caused loss of life and massive damage to public and private property. Seven percent of the regional damage is in New York, mostly in Westchester – the remainder is in Connecticut. Damages from a recurrence of either the 1938 or 1954 floods are estimated at $64 million. Average annual tidal flood damages are estimated at $11 million in 1970, and could rise to $32 million by 2020, if past trends continue and no additional damage abatement measures are taken. Total damages over this fifty year period are estimated at $1 billion. Table 2.10-1 summarizes these damages by subregion.

Average annual **riverine flood** damages are estimated at $6 million in 1970, $10 million in 1990, and $19 million in 2020. The worst storm expected in 100 years would produce damages fourteen times larger. Almost all damage is in the Connecticut portion of the study region. Table

TABLE 2.10-1 Estimated Tidal Flooding Damages (in Millions of 1970 Dollars)[a]

Subregion	Shore (Miles)	Average Annual Damages 1970	1990	2020	1938 Hurricane 1970	1990	2020
1 Southeastern Ct.	154	2.5	4.0	7.5	30.0	48.0	90.0
2 Ct. River Estuary	63	.8	1.3	2.5	5.4	8.6	16.2
3 South Central Ct.	86	1.7	2.8	5.2	5.5	8.8	16.5
4 Greater Bridgeport Valley	45	2.9	4.6	8.6	6.0	9.6	18.0
5 Southwestern Ct.	77	2.4	3.8	7.1	13.0	20.8	39.0
6 Westchester, Bronx, Nassau	114	.3	.5	1.0	3.2	5.1	9.6
7 West Suffolk	85	.1	.2	.3	1.1	1.7	3.3
8 Central Suffolk	39	*	*	.1	.2	.4	.7
9 East Suffolk	18	*	*	*	*	*	*
TOTAL	681	10.7	17.2	32.3	64.4	103.0	193.3

*Minor

a. Flood Damage Reduction Planning Report.

2.10-2 summarizes these damages by subregion.

What can be done to reduce the flood damage

In 1973, Congress passed the Flood Disaster Protection Act (P.L. 93-234) which (1) requires states or local communities with flood prone properties, as a condition of future federal financial assistance within the flood hazard areas, to participate in the federal flood insurance program and to adopt adequate flood plain ordinances with effective enforcement provisions; and (2) prohibits financial assistance by federal programs or any loan by a federally insured, regulated, or supervised lending institution for purchase or improvement of land or facilities in a designated flood hazard area without flood insurance coverage equal to the outstanding principal of the loan or grant. This legislation was prompted by the alarming rate of increase nationwide in annual flood losses. The study believes that this legislation is so strong that it will eliminate virtually all *new* damage-prone development in the flood plain. Flood control structures to protect existing development, if not built by 1990, will probably never be built. The legislation also means that the flood insurance program is the key to future wise use of the flood plains, and ultimately will be responsible for the local adoption of land use regulations and flood proofing requirements.

With the objective of minimizing flood damages through environmentally, economically, and socially acceptable means, the following seventeen alternative measures—grouped in five classes—were considered:

I. Reduce Flooding
   - Modify hurricanes
   - Control surface runoff
   - Impound flood waters
   - Increase channel capacity
   - Confine flood waters

TABLE 2.10-2 Estimated Annual Riverine Flooding Damages (in Millions of 1970 Dollars)[a]

Subregion	Streams with Major Damage	Flood Plain Acres	Damages 1970	1990	2020
1	Thames River, Shetucket River	16,480	.8	1.2	2.4
2	Chester Creek	5,100	.3	.5	1.0
3	Quinnipiac River	14,150	1.8	2.8	5.3
4	Ash Creek, Pequonnock River	3,770	1.2	1.9	3.5
5	Rippowan, Noroton & Norwalk	6,330	1.8	3.0	5.5
6	Mamaroneck & Sheldrake Rivers	720	.3	.5	.9
7, 8, 9	None	*	*	*	*
	TOTAL	46,550	6.2	9.9	18.6

*Minor

a. Flood Damage Reduction Planning Report.

2. Control Flood Plain Development
   - Relocate–multipurpose
   - Regulate land use
   - Educate the public
   - Control finance
   - Apply other government programs
3. Minimize Damages From Flooding
   - Floodproof–voluntarily
   - Floodproof–mandatorily
   - Forecast, warn, evacuate
4. Accept the Damages
5. Mitigate Suffering from Damage
   - Use federal insurance
   - Use commercial insurance
   - Assist in emergencies

Hurricane modification to reduce peak winds or alter a hurricane's path by a few degrees seaward is not yet technically feasible. However, experts believe that the capability could be developed by or before the year 2000. This alternative holds great promise as a damage reduction tool, particularly for tidal flooding. Although it would reduce erosion, sedimentation, and water quality problems, as well as threats to life, the legal, climatological, and ecological questions will have to be answered before such a program begins.

The **structural solutions** considered emphasized dikes and seawalls for tidal flooding and dams, channel work, and non-structural land treatment for riverine flooding. About fifty tidal and a similar number of riverine projects were considered. Most were dismissed as economically unjustifiable. The balance were evaluated for environmental and social desirability. The few that survived this evaluation process are listed in Table 2.10-4 near the end of this section. It must, however, be cautioned that most of the surveys on which these projects were based were carried out before serious consideration of non-structural alternatives was mandated. Both Connecticut and New York State prefer non-structural alternatives wherever feasible. Therefore, as part of the next phase of study for each of these projects, alternative non-structural solutions would be evaluated and possibly recommended.

Floodproofing – whereby individual buildings and their contents are floodproofed by structural changes and adjustments – is limited in its application, mainly due to cost. However, it does have promise in one or more of the following situations:

- Where moderate flooding with low stage, low velocity, and short duration is experienced. This situation fits most headwaters and the small watersheds draining directly into the Sound.
- Where other types of flood protection are not feasible.
- Where individuals desire to solve their flood problems without collective action.
- Where activities dependent on waterfront location need some degree of protection.
- Where a higher degree of protection is desired than that provided by other flood control methods.

Even where economically feasible, lack of federal assistance, the availability of a more effective flood control measure, or several other factors can limit its use. It should, however, be more widely used as towns pass new flood plain ordinances and building code modifications to qualify for the flood insurance program.

Regulation of land use is essential for prevention of new development in flood-prone areas. Techniques include establishment of encroachment lines, flood plain zoning, acquisition of development rights, and subdivision regulations. Although these techniques have not been used very effectively in the past, the incentives provided by the 1973 Flood Disaster Protection Act should induce their full utilization in the future. Evaluations of each of these specific measures are included in the planning report Flood Damage Reduction.

Relocation was found to be uneconomical as strictly a flood damage abatement measure. But where recreational or other benefits could be derived as well, particularly along beaches, it became a real bargain. The flood damage reduction benefits at each relocation area are less than one percent of total damages. However, when all the sites are added together, the benefits amount to greater than 10 percent of the damages. Since these relocation projects are primarily for recreation benefits, they are listed in Section 2.3 Outdoor Recreation.

Evaluation of alternative plans

Three alternative plans were formulated and evaluated, one emphasizing environmental quality, one economic development, and the third the recommended plan. The costs and damage reduction benefits of each are shown in Table 2.10-3.

The environmental quality plan emphasizes land use regulations, control of surface runoff, and the use of conservation-oriented government programs. It includes five tidal and nine riverine flood control projects, voluntary and mandatory flood proofing, improved forecast-warning-evacuation services, and emergency assistance. However, it rejects hurricane modification, most projects – including tidal barriers and other major structures which would tend to reduce the presumed beneficial and renewal effects of occasional major flooding of estuarine and riverine systems – and educational and financial programs not geared to environmental ends. In general, it is attracted to the most effective ways of improving or maintaining the natural environment of flood plains.

The economic development plan emphasizes flood control structures (five tidal and three riverine in addition to those in the environmental quality plan), voluntary flood proofing, improved forecast-warning-evacuation services, and emergency assistance. In general, it includes the most cost-effective ways of reducing flood damage. It accepts mandatory flood proofing and most other government programs related to flooding, but rejects a few projects, educational and financial policies, land use regulations, and flood insurance.

TABLE 2.10-3 Comparison of Alternative Plans (in Millions of Dollars)[a]

	Without Plan	Environmental Quality Plan	Economic Efficiency Plan	Recommended Plan[b]
Tidal Flooding:				
1990 Damages	17	10	8	9
2020 Damages	32	15	7	5
1970–2020 Damages	1,020	580	410	405
Plan Costs		60	82	78
Riverine Flooding:				
1990 Damages	10	4	4	5
2020 Damages	19	7	7	7
1970–2020 Damages	590	260	280	290
Plan Costs		56	53	49

a. Flood Damage Reduction Planning Report.

b. Damages and costs for the recommended tidal flooding plan are computed, for comparison purposes only, assuming the construction of flood control structures at the seven sites identified in recommendation.

Recommended Actions

The recommended plan will cut aggregated flood losses over the next fifty years by one billion dollars. Nine small watershed projects are included at a cost of $25 million, with the federal share being 50-70 percent of each. Seven tidal flood prone areas are also recommended for further study of alternative solutions. About 20 percent of the damage in 2020 (and 50 percent in 1990) are beyond control in environmentally, economically, and socially acceptable ways.

The study has indicated that some of this loss, but by no means all of it, could be cut further by application of some structural measures in some highly developed coastal areas. However, the study team has been impressed by the fact that those in the local areas who stand to benefit from these measures have repeatedly rejected them on the grounds of cost and perceived adverse environmental effects. It is therefore unlikely that these measures will again be considered seriously until after the next flood. Despite the very strong measures built into the Flood Disaster Protection Act of 1973 to discourage new unprotected development in the flood plain, there are sure to be problems relocating established development out of the historically developed downtown and often flood prone areas of coastal municipalities. The effectiveness of discouraging new development also poses serious challenges. Put another way, even with the diligent application of the study's recommended land use measures, as well as upstream riverine structures, the region still faces the certainty of serious hurricane tidal flood losses sometime in the foreseeable future.

The eight point plan is listed below. The percent damage reduction for each measure is only an estimate. Backup detail may be found in the Flood Damage Reduction Planning Report.

1. **Flood plain management.** All towns with areas formally designated by the U.S. Department of Housing and Urban Development as flood hazards should adopt required regulations to qualify for the National Flood Insurance Program by 1975 or twelve months from their date of notification, whichever is later. The states of Connecticut and New York should continue working with the municipalities to see that the muncipalities qualify for and that property owners are made fully aware and encouraged to purchase the flood insurance. Recently passed New York legislation will require the state to step in to establish necessary regulations to qualify for the insurance if the municipality does not meet requirements within time limitations. Connecticut should do likewise. This program will provide the impetus for the following damage reduction measures.
   a. **Regulation of land use.** Stricter flood plain zoning, building code regulations, and other land use regulations should account for about 10 percent of the damage reduction. See the Flood Damage Reduction Planning Report for outlines of model flood hazard zoning ordinances.
   b. **Voluntary flood proofing.** To reduce expected flood losses by about 5 percent, Connecticut should implement by 1975 a program to educate its flood plain occupants on available flood proofing techniques.
   c. **Mandatory flood proofing.** To reduce expected flood losses by about 5 percent, Connecticut should encourage and assist its municipal and town governments in flood prone areas to study and adopt flood-conscious building and housing codes by 1975.
   d. **Public education.** This is a key component of the process of developing the local flood plain ordinances and should reduce losses by about 2 percent.

2. **Pilot flood plain management studies.** The U.S. Army Corps of Engineers, with state and New England River Basins Commission assistance, should conduct detailed tidal flood plain management studies by 1980 for one community each in Connecticut and New York to develop alternative plans for flood damage reduction using different combinations of structural and non-structural techniques for each. Evaluation of the alternative plans should include social, economic, and environmental impacts, and public acceptability. Implementation mechanisms for each alternative plan should also be specified.

The studies should utilize the planning handbooks developed in the Connecticut River Basin Supplemental Study, and serve as a model for design and adoption of programs and policies for flood plain management throughout the coastal area of each state. In addition, the studies should develop specific guidelines for the development of similar plans in other coastal communities in each state.

3. **Provide flood control structures.** To reduce expected flood losses by about 10 percent, the Soil Conservation Service should develop nine locally sponsored riverine flood control projects in accordance with the schedule shown in Table 2.10-4. An integral part of each project must be a land use management program, with appropriate local cooperation, to prevent overextension of development in the protected area.

4. **Study tidal flooding areas.** The U.S. Army Corps of Engineers, with appropriate state and local support, should study alternative solutions (perhaps by funding provided under Section 73 of the 1974 Water Resources Development Act) to flood threats at Thamesville, Montville, New London, Point of Woods, Stratford, Fairfield, (Pine Creek), and Westport (Compo Beach), and prepare detailed recommendations by 1985. Structural solutions, if implemented, would cost $27.6 million and reduce total regionwide (inland and coastal) damages by about 20 percent.

5. **Modify hurricanes.** To reduce expected flood losses by about 15 percent, the National Oceanic and Atmospheric Administration should intensify its current research efforts and achieve an environmentally and socially acceptable capability by 2000 or earlier to modify hurricanes threatening the region or to divert them out to sea.

6. **Redevelop selected flood prone areas for public recreation and other use.** Connecticut and New York should set aside funds from revenue bonds to acquire, or assist municipalities to acquire, needed public access to the water and recreation areas consistent with the recommendations of the state coastal zone management programs. Section 2.3 Outdoor Recreation lists several potentials for state and local acquisition. This should reduce flood losses by about 10 percent.

7. **Improve forecasting, warning and evacuation services.** The National Weather Service should improve its current capability to forecast the paths and intensity (tidal flood surge) of hurricanes and other severe storms, and should expand its riverine and tidal flood prediction and warning services. The expected reduction in tidal flood losses is about 3 percent, but may be considerably higher in the case of riverine flooding.

8. **Assist in emergencies.** To mitigate human suffering, the Department of Housing and Urban Development and the U.S. Army Corps of Engineers should maintain their current capabilities to assist during flood disasters.

TABLE 2.10-4 Flood Control Projects in the Recommended Plan

Subregion/Project	Primary Responsibility	Annual Flood Damages Abated ($Million) 1990	Annual Flood Damages Abated ($Million) 2020	Cost, Present ($Million)
First Priority:				
1–Yantic R.	SCS	.6	1.2	7.3
3–Harbor Brook	SCS	.2	.4	2.0
3–West R. (N. Haven)	SCS	.3	.6	3.0
3–Neck R.	SCS	nil	nil	0.1
3–Munger Brook	SCS	nil	nil	0.3
3–Farm R.	SCS	.1	.1	1.0
3–Farm Brook	SCS	.2	.4	1.6
5–Norwalk R.	SCS	.7	1.3	5.2
6–Blind Brook	SCS	.3	.5	4.0
TOTAL		2.4	4.5	24.5

Erosion and Sedimentation

Causes and Effects of Erosion

Erosion of the land by the forces of nature is a continuous process. Daily tides and constant wave action slowly alter the shape of beaches and other shorelands around the Sound. They push sediments and bottom materials back and forth, filling in harbors and navigation channels. Constant wind and wave action erodes the bluffs along the north shore of Long Island. While not a major problem in this region, rainfall and snow melt wash soil from the region's upland into rivers, lakes, and streams, impeding their flow and temporarily muddying their waters. With man's help, this run-off also introduces pesticides, nutrients, coliform bacteria, oxygen demanding wastes, and other pollutants to the waters, causing damage to fish and other marine life. Eventually, much of this sediment reaches the Sound, further adding to the murkiness and pollution of its waters and the filling of its harbors. This is not to say that these forces of nature are without benefit. Indeed, the normal processes of erosion and sedimentation play a key role in the vitality of the region's ecosystem.

During frequent storms and occasional hurricanes, the whole process speeds up. Entire beaches can be carried away and the course of streams diverted in a few hours. Where homes, roads, and other man-made structures stand in the way, they are damaged or destroyed. Even structures erected to stem this tide are often ineffective. Indeed, man's long struggle against these natural forces has met with little success. In many cases, urban development has aggravated the problem and accelerated the erosion and sedimentation process. It is clear now that the natural forces cannot be overcome. Therefore, unless the erosion and sedimentation can be stopped—as at a construction site—losses can be reduced only by limiting use of the shorefront and other erodible sites.

Coastal erosion is a critical problem in the region. Most of the north shore of Long Island is eroding at one to two feet a year with a few locations receding at a rate up to 3.5 feet a year. Twenty-six miles, or about 10 percent of the Connecticut shoreline are disappearing at 1 to 1.5 feet per year. Navigational channels, especially in Connecticut, silt up with sediments which would cause disruption and added expense to marine transportation without periodic dredging to keep them open and safe. There are further losses when homes, other buildings, and erosion control structures are damaged and it is necessary to clean up deposited material after storms. All of this costs money—an estimated $840 million over the next fifty years if remedial measures are not taken. See Table 2.11-1 for a summary of the present and projected damages in the region.

TABLE 2.11-1 Estimated Annual Coastal Erosion and Sedimentation Damages [a] (In Thousands of 1970 Dollars)

	1970 Erosion Damage						Projected Future Damages			
							1990		2020	
	Land loss	To erosion control structures & cleanup	To buildings	Total 1970 erosion	1970 sedim. damages	Total 1970 damages	Eros.	Sed.	Eros.	Sed.
Conn.	940	630	320	1,890	1,730	3,620	2,840	2,590	5,670	5,190
N.Y.	4,200	250	480	4,930	520	5,450	7,390	790	14,790	1,560
TOTAL	5,140	880	800	6,820	2,250	9,070	10,230	3,380	20,460	6,750

a. Erosion and Sedimentation Planning Report.

Upland erosion, while less serious than in many parts of the country, is nevertheless significant. Urban construction and inadequate soil conservation on other lands in the Sound drainage area result in an average annual soil loss of 1.35 tons per acre. Rates for streambanks, construction sites, and untreated cropland are much higher, however, averaging 213, 32 and 10 tons per acre respectively.

The resulting sediment can fill stream channels, reduce the storage capacity of reservoirs, damage highways, and railroads with sediment deposits, and cause pollution, thus reducing the aesthetic and recreational appeal of streams, lakes, and ponds. However, some sedimentation can be beneficial, as well, by providing material for wetland growth, providing nutrients for aquatic organisms, and improving production of some flood plain soils. Excluding these unquantified benefits, without remedial action upland erosion and sedimentation damages are estimated at $550 million over the next fifty years (see Table 2.11-2).

TABLE 2.11-2 Estimated Annual Upland Erosion and Sedimentation Damages[a] (in thousands of 1970 dollars)

	1970	1990	2020
Erosion	8,796	10,790	11,820
Sedimentation	287	353	387

a. Erosion and Sedimentation Planning Report.

What can be done to reduce erosion and sedimentation losses

With the objective of minimizing losses from erosion and sedimentation in economically, environmentally, and socially acceptable ways, the study considered seven coastal and six upland alternative measures. They are listed in Table 2.11-3 together with their summary environmental, economic, and social evaluations.

For coastal erosion and sedimentation, the study concludes that, except for prohibiting new development in erosion-prone areas, damage prevention measures are largely unrewarding. Unless there are public recreational benefits to be gained, construction of beach retention structures and replenishment of lost sand cannot be justified economically. This must be done selectively, however, or the structures may actually aggravate the erosion problems. This is particularly true on the north shore of Long Island. Planting of special dune and beach grasses can help stabilize some of the bluffs, but with the possible result of losing the beach below. Long Islanders will simply have to respect nature's reclaiming these bluffs.

The most effective measures found to prevent or remedy coastal damages include restricting new building in erosion-prone areas, maintenance and repair of existing structures, and dredging navigational channels. The first measure is of limited utility since only about 5 percent of the erosion losses by 1990 and 10 percent by 2020 could be attributable to damage to new buildings. Maintenance of existing erosion control structures at public beaches is a state responsibility and is considered generally desirable, for failure to maintain them will probably cause a reversion to conditions existing before the structures were installed.

Dredging navigation channels has many opponents, primarily because of problems with disposal of the often polluted dredge spoils. See Section 2.1 Water Management for policy on future dredging. Section 2.6 Marine Transportation recommends a program of port consolidation which would cut future maintenance and improvement dredging substantially. Also, the spoil material, whenever possible, should be used for creation of artificial islands or wetlands, so that productive use could be made of the material.

Building new beaches does not provide substantial erosion control benefits, only about one-tenth of their cost. However, when public recreational benefits are added in as well, beach building benefits can exceed costs by three to six times. The U.S. Army Corps of Engineers is authorized to undertake beach restoration and protection studies. As much as 70 percent of the cost of protecting publicly owned shore may come from federal funds if certain conservation, development (park type), and use requirements are satisfied. Projects involving only beach use may still receive as much as 50 percent federal funding. Since this is principally then a recreational measure, further evaluation and recommendations are included in Section 2.3 Outdoor Recreation.

Measures to reduce upland erosion and sedimentation damages are generally far more practical and feasible than those for coastal damages.

Control of losses at construction sites. At construction sites, the sediment damages are generally more significant than the erosion. Providing debris or sediment basins, runoff diversions, benches and berms, and other structural measures at these sites can effectively control sedimentation, which can be particularly harmful to water quality and aquatic life.

Control of losses from urban lands. These losses, although less intense than the construction site losses, are more widespread and account for about half of the total upland erosion damages throughout the region. Controlling urban land uses through site planning, building codes, retention of vegetative cover, and related measures can reduce upland losses by about 35 percent. Benefits to water quality and fisheries are also substantial.

Control of losses from agricultural and forest lands follows many of the same principles as those for urban sources and construction sites. In addition, the use of sound farming practices such as contour farming, strip cropping, soil conservation tillage methods, and the maintenance of forested buffer strips along streams are also beneficial and will

TABLE 2.11-3 Summary Evaluation of Alternative Damage Reduction Measures[a]

Alternative Damage Reduction Measures	Overall Evaluation		
	Environmental Quality	Economic Development	Social Well-being
Coastal:			
Regulate land use	Good	Poor	Fair
Maintain existing erosion control structures	Good	Good	Good
Build new structures	Poor	Fair	Poor
Add sand to existing beaches	Fair	Poor	Good
Build new beaches	Fair	Poor	Good
Dredge navigation channels	Poor	Good	Good
Accept the damage	Fair	Poor	Poor
Upland:			
Control losses at construction sites	Good	Poor	Good
Control losses from urban land	Good	Fair	Fair
Control losses from agricultural and forest lands	Good	Good	Good
Control losses on roadbanks	Good	Fair	Good
Control losses on streambanks	Fair	Poor	Fair
Accept the damage	Poor	Poor	Poor

a. Erosion and Sedimentation Planning Report.

eliminate or reduce the amount of sediment entering streams and other water areas. Federal cost sharing assistance is available for many agricultural conservation practices. Together these measures can reduce upland losses in the region by about 20 percent.

Control of erosion from roadbanks must concentrate on transporting storm runoff from one elevation to another without slope damage. Through a combination of structural and non-structural measures, soil loss and roadbank damage can be effectively controlled. Examples of the former would include storm drains, chutes, and catch basins; and in the latter case, the stable design of embankments using the principles of soil mechanics and vegetative cover.

Streambank erosion on the other hand, although the most intense form of erosion, can only be controlled through expensive structural measures, such as stabilizing the banks with bulkheads or riprapping or reducing the velocity of the moving water with checkdams. These structures would also reduce wildlife habitat and scenic appearance. Consequently, they are not recommended.

Evaluation of alternative plans

Three alternative plans were considered for reducing erosion and sedimentation along the coast and upland, each one utilizing one or more of the measures described above.

One plan, stressing environmental quality (EQ), would regulate land use in coastal erosion-prone areas and maintain existing erosion control structures. It would reduce total coastal damages from $13.6 million to $12.1 million in 1990 and from $27.2 million to $24 million in 2020, at a total cost of $10.4 million. For upland erosion the plan would include measures to control urban, agricultural, and construction site losses, and protect roadbanks. It would reduce total annual upland damages from $11.1 million to $4.7 million in 1990, and from $12.2 million to $5.1 million in 2020, at a total cost of $29 million.

A second plan, stressing economic efficiency (ED), for coastal erosion and sedimentation, would maintain existing erosion control structures and dredge channels. It would reduce total coastal damages from $13.6 million to $8.9 million in 1990, and from $27.2 million to $17.8 million in 2020, at a cost of $24.9 million.

To deal with upland damages, the plan would control urban and agricultural losses and protect roadbanks. Its damage reduction capability and total cost is about the same as the environmental quality plan for upland erosion and sedimentation. See Table 2.11-4 for a summary of the costs and damage abatement under the alternative plans.

Recommended plan

The recommended plan is expected to reduce average annual coastal erosion and sedimentation losses from about $14 million to $9 million in 1990, and from about $27 million to $17 million in 2020, an aggregate saving of about $360 million over the next fifty years. However, 85 percent of the erosion damages are accepted as beyond solution. Esti-

TABLE 2.11-4 Comparison of Alternative Plans (All Figures in Millions of Dollars)[a]

Alternative Plan	Coastal damages accepted	Coastal damages reduced	Coastal costs (total)	Upland damages accepted	Upland damages reduced	Upland costs (total)
Environmental Quality Plan:						
1990	12.1	1.5		4.7	6.4	
			10.2			29
2020	24.0	3.2		5.1	7.1	
Economic Efficiency Plan:						
1990	8.9	4.7		4.7	6.4	
			24.9			29
2020	17.8	9.4		5.1	7.1	
Recommended Plan:						
1990	8.7	4.9		4.7	6.4	
			26.1			29
2020	17.2	10.0		5.1	7.1	

a. Erosion and Sedimentation Planning Report.

mated cost is $26 million, of which the federal government would pay $16 million for the cost of dredging.

For upland erosion and sedimentation, the recommended plan is expected to reduce average annual losses from $11 million to $5 million in 1990, and from $12 million to $5 million in 2020, an aggregate saving of about $360 million over the next fifty years. Estimated cost is $29 million, of which the federal government would pay 25 percent.

The plan is summarized in the eight point program below. Detailed background information is available in the Erosion and Sedimentation Planning Report, published separately.

1. **Accept most coastal erosion damages.** Recognize that about 85 percent of coastal erosion damages are beyond practical remedy in environmentally, economically, and socially acceptable ways.

2. **Reduce urban losses with non-structural measures.** To reduce upland erosion and sedimentation losses by about 35 percent and coastal losses by about 2 percent, and protect water quality and aquatic life, the Connecticut Department of Environmental Protection and New York Department of Environmental Conservation should establish standards by 1978 for non-structural control of urban erosion, and require adoption of local land use controls to comply by 1980. In the event of non-compliance, the state would establish the regulations.

3. **Dredge channels.** To reduce coastal erosion and sedimentation losses by about 25 percent, the U.S. Army Corps of Engineers, with the approval of the affected state and in coordination with the proposed petroleum receiving and distribution authorities, should continue to dredge channels as needed for safe navigation.

4. **Control agricultural and forest losses with non-structural measures.** To reduce upland erosion and sedimentation losses by about 15 percent, the USDA Soil Conservation Service and Forest Service should intensify their current programs through Soil and Water Conservation Districts with the aim of having cooperative conservation plans developed for 60 percent of the agricultural and forest area in the region by 1990.

5. **Control agricultural losses with structural measures.** To reduce upland erosion and sedimentation losses by an estimated 5 percent, the U.S. Soil Conservation Service should continue its current program through Soil and Water Conservation Districts with the aim of having structural measures applied in at least 70 percent of the justified agricultural locations by 2000.

6. **Control roadbank erosion.** To reduce upland erosion and sedimentation losses by about 5 percent, the Connecticut and New York Departments of Transporation, with the assistance of the Soil Conservation Service, should establish guidelines for roadbank erosion control on new and existing highways, including inspection and maintenance programs. The aim should be to correct at least 70 percent of the significant problem areas by 1990.

7. **Maintain existing structures.** To reduce coastal erosion and sedimentation losses by about 10 percent, Connecticut and New York should continue to inspect and maintain existing federally and state built beach erosion control structures annually.

8. **Demonstration Project.** Both states and the U.S. Army Corps of Engineers should encourage ongoing research into wave energy dissipation systems. Consideration should be given to developing a small demonstration project along a section of Suffolk County's north shore, with funding provided under the provisions of the Shoreline Erosion Control Demonstration Act of 1974.

3 The Plan by Subregion

Map Folio

3.1 Southeastern Connecticut Subregion 1

3.2 Connecticut River Estuary Subregion 2

3.3 South Central Connecticut Subregion 3

3.4 Greater Bridgeport and the Lower Housatonic Valley Subregion 4

3.5 Southwestern Connecticut Subregion 5

3.6 Westchester, the Bronx and Queens Subregions 6A & B

3.7 Nassau County Subregion 6C

3.8 Eastern Long Island Subregion 7, 8 & 9

Map Folio

The following section shows the proposals of the Long Island Sound Study for each of its nine subregions. Most of these proposals will need more detailed site specific study, as well as public scrutiny and support, before they can be implemented. The land use and natural resource information shown on each of these maps is a graphic simplification of the more detailed information presented in the fold-out regional *Land Use and Critical Natural Resources Map.*

LAND USE AND CRITICAL NATURAL RESOURCES.

DEVELOPED LANDS: Commercial, industrial, and residential areas.

PUBLICLY OWNED OPEN LANDS: Major national, state, county and municipal parks, forests and wildlife and hunting preserves.

CRITICAL NATURAL RESOURCE LANDS: Prime agriculture and forest lands and critical water-related lands.

RECOMMENDED ACTIONS

WASTEWATER TREATMENT PLANT IMPROVEMENTS: Upgrade from primary to secondary (New London and Norwich), construct new secondary plants (Stonington Borough and Montville).

MARINE TOILET WASTE HANDLING FACILITIES: Develop at selected wastewater treatment plants and locate pump-out trailers at key recreational harbors.

NO DISCHARGE ZONES: Designate and preserve the area between Baker's and Andrews Islands (Mystic), Jordan Cove (Waterford), Niantic Bay, and the Poquonock River.

SURFACE WATER SUPPLY SOURCES: Develop Joe Clark Brook (Reservoir) and Shewville Brook (diversion).

SCENIC TOWNSCAPES: Designate and protect Stonington Borough, North Stonington, Mystic Center, and parts of Norwich.

RECREATIONAL FERRY SERVICE

BOAT LAUNCH LANES

PRIVATE MARINA DEVELOPMENT POTENTIAL

FLOOD CONTROL: On the Yantic River, develop a flood control project including a dam, land treatment, and channelization. At Thamesville and Montville, study both structural and non-structural abatement measures.

OTHER: 1) Supplement regional water supply needs by ground water development in Bozrah, Colchester, Franklin, East Lyme, Griswold, Lisbon, Stonington, North Stonington, Salem, Sprague and Voluntown.
2) Phase out solid waste disposal sites in Groton, New London, Bozrah, Ledyard, Montville, and Waterford.

Subregion 1
SOUTHEASTERN CONNECTICUT

Susquehanna Plains: State purchase 2200 acres; develop 250 picnic sites, 100 camp-sites, and limited boat and canoe access to the Shetucket River.

Hopeville Pond State Park: State purchase additional 90 acres; develop 400 picnic sites.

Beach Pond: State purchase 450 acres; develop swimming area, 500 picnic sites, and 200 campsites.

Pachaug Pond: State purchase 700 acres; develop swimming area, 500 picnic sites and 200 campsites.

Green Fall Pond: State purchase an additional 235 acres; develop swimming area; 100 picnic sites, and limited boating facilities.

Hopemead State Park: State purchase 800 additional acres; develop swimming area, 500 picnic sites, and about 200 campsites.

Mohegan-Pequot State Park (proposed): State purchase additional 350 acres; develop 200 picnic sites.

New London to Rhode Island border: Designate and preserve selected shore and upland areas east of New London as special scenic zones.

Powers Lake: State purchase 900 acres (if and as available); develop 100 picnic sites and boating facilities.

Rocky Neck State Park: As part of the "Long Island Sound Heritage" the State should annex to the existing park undeveloped portions of the soon-to-be abandoned Niantic State Farm for Women (including Bride Lake). State development of an erosion control structure on the shore should restore 0.6 mile of beach.

New London Harbor/Thames River: 1) Phase out residual oil transshipment (via the Connecticut River to Middletown) with the development of a New Haven to Middletown heated pipeline by 1985. 2) Develop a 12-acre inland oil storage tank farm in Norwich by 1990. 3) Develop a public marina at New London. 4) Construct at least one fishing pier at Ocean Beach in New London.

Bluff Point State Park: As part of the "Long Island Sound Heritage," the State should develop the southeastern beach area here by 1977. Development inland and on the western shore should be limited to insure its preservation as a casual recreation natural area.

Mystic Islands: As part of the "Long Island Sound Heritage," the State should acquire three of the Mystic Islands by 1980. **Ram Island** should be developed to include about 0.5 mile of beach and recreational ferry service in conjunction with Bluff Point. **Dodges and Andrews Islands** should be preserved as wildlife conservation areas.

Subregion 2

CONNECTICUT RIVER ESTUARY

LAND USE AND CRITICAL NATURAL RESOURCES.

DEVELOPED LANDS: Commercial, industrial, and residential areas.

PUBLICLY OWNED OPEN LANDS: Major national, state, county and municipal parks, forests and wildlife and hunting preserves.

CRITICAL NATURAL RESOURCE LANDS: Prime agriculture and forest lands and critical water-related lands.

RECOMMENDED ACTIONS

SECONDARY WASTE WATER TREATMENT PLANT CONSTRUCTION

MARINE TOILET WASTE HANDLING FACILITIES: Develop at the proposed waste water treatment plants and locate pump-out trailers at key recreational harbors.

NO DISCHARGE ZONES: Designate and preserve the Hammonasset River and the area along the Fenwick shore.

SURFACE WATER SUPPLY SOURCES: Raise the Wilcox and Killingworth Reservoirs twenty feet, divert waters from the Menunketesuck River and Murray Ponds to the Killingworth Reservoir.

SCENIC TOWNSCAPES: Designate and protect Essex Center, Chester Center, Lyme Street in Old Lyme, Saybrook Point, Clinton Center, and Hadlyme.

RECREATIONAL FERRY SERVICE

TIDAL FLOOD-PRONE AREAS: Potential for local long term acquisition for recreation; Plum Bank and Great Hammock Beaches in Old Saybrook (0.9 mile), Sound View in Old Lyme (0.5 mile), Cedar Island in Clinton (0.1 mile), and Duck Island Roads in Clinton and Westbrook (1.5 miles).

PRIVATE MARINA DEVELOPMENT POTENTIAL

OTHER: 1) Supplement regional water supply needs through system regionalization and ground water development in Essex, Lyme, Old Lyme, Chester, Deep River and Clinton.
2) Phase out solid waste disposal sites in Old Saybrook, Westbrook, Chester, Deep River, Essex, and Clinton.

Green Triangle: Designate and preserve portions of the valleys and ridge tops between Branford, Old Lyme, and Middletown as a special scenic zone.

Chatfield Hollow State Park: State should purchase an additional 160 acres from the New Haven Water Company and secure limited recreational rights to 440 acres of water company land.

Eustasia Island: State purchase as wildlife preservation-nature observation area.

Messerschmidt Pond: State purchase 500 acres; development might include 250 picnic sites and 100 campsites.

Hammonasset State Park: State purchase additional 500 acres on the east and west sides of the River, including wetland area. Development should include 200 picnic sites, 200 campsites, expansion of the existing nature center into a "Classroom by the Sound," and hiking paths.

Connecticut River: 1) Phase out petroleum-laden barges; route products instead to New Haven for transport to Hartford via a "clean products" pipeline (gasoline and home heating oil) and to Middletown via a heated pipeline

2) Locate oil spill containment equipment at a lower Connecticut River town.
3) Develop a public marina in Old Saybrook.
4) Develop a recreational terry service from Old Saybrook and Essex to the lower River islands and Selden Neck State Park.

LAND USE AND CRITICAL NATURAL RESOURCES

DEVELOPED LANDS: Commercial, industrial, and residential areas.

PUBLICLY-OWNED OPEN LANDS: Major national, state, county, and municipal parks, forests, and wildlife and hunting preserves.

CRITICAL NATURAL RESOURCE LANDS: Prime agricultural and forest lands and critical water-related lands.

RECOMMENDED ACTIONS

WASTE WATER TREATMENT PLANT IMPROVEMENTS: Upgrade from primary to secondary (East Shore, Boulevard and East Street, New Haven), expanded secondary (Meriden, Wallingford, and Branford – with extended Sound outfall), construct new secondary plant (Guilford).

MARINE TOILET WASTE HANDLING FACILITIES: Develop at selected waste water treatment plants and locate pump-out trailers at key recreational harbors.

NO DISCHARGE ZONES: Designate and preserve the water area off Hammonasset and Seaview Beaches, extending westerly to Sachems Head, (Madison and Guilford).

SURFACE WATER SUPPLY SOURCES: Divert flood flows from the Coginchaug, Muddy, and North Madison Rivers; construct a rapid sand filtration plant at Lake Whitney; increase the holding capacity of the Parmallee Brook Reservoir; and develop a pumping station at Lake Gaillard.

SCENIC TOWNSCAPES: Designate and protect Guilford Center, Madison Center, and parts of New Haven.

RECREATIONAL FERRY SERVICE: Private marina development potential.

TIDAL FLOOD – PRONE AREAS: Identified as having potential for local long-term acquisition for recreation: Circle and East River Beaches in Madison (0.6 mile), Silver Sands and Momauguin Beaches in East Haven (1.0 mile) and Milford Point Beach in Milford (0.7 mile).

FLOOD CONTROL: Develop flood control projects including dams, land treatment, and channelization on the Farm River (East Haven), Farm Brook (Hamden), Neck River (Madison), Harbor Brook (Meriden), Munger Brook (North Branford), and West River (Woodbridge).

OTHER:

1) Supplement regional water supply needs by ground water development in Cheshire, Guilford, Meriden, North Haven, and Wallingford.

2) Phase out existing solid waste disposal sites in Milford, West Haven, New Haven, East Haven, Branford, and Guilford.

Subregion 3

SOUTH CENTRAL CONNECTICUT

Lake Watrous Watershed: Develop limited recreation facilities including 50 picnic sites and hiking trails on watershed of utility-owned land.

Sleeping Giant State Park: State purchase additional 275 acres; develop 200 picnic sites.

Green Triangle: Designate and preserve portions of the valleys and ridge tops between Branford, Middletown, and Old Lyme as special scenic zones.

Lake Gaillard Watershed: Develop limited recreation facilities including 200 picnic sites and hiking trails on watershed of utility-owned land

Maltby Lakes Watershed: Develop limited recreation facilities including 50 picnic sites and hiking trails on watershed of utility-owned land.

Fort Hale Restoration Project: Develop a "Classroom by the Sound" nature center.

Turkey Hill: State purchase 300 acres; develop about 200 picnic sites.

West Haven Beach: Develop additional parking and beach area (Sandy Point to fishing pier; 2.0 miles) by 1980.

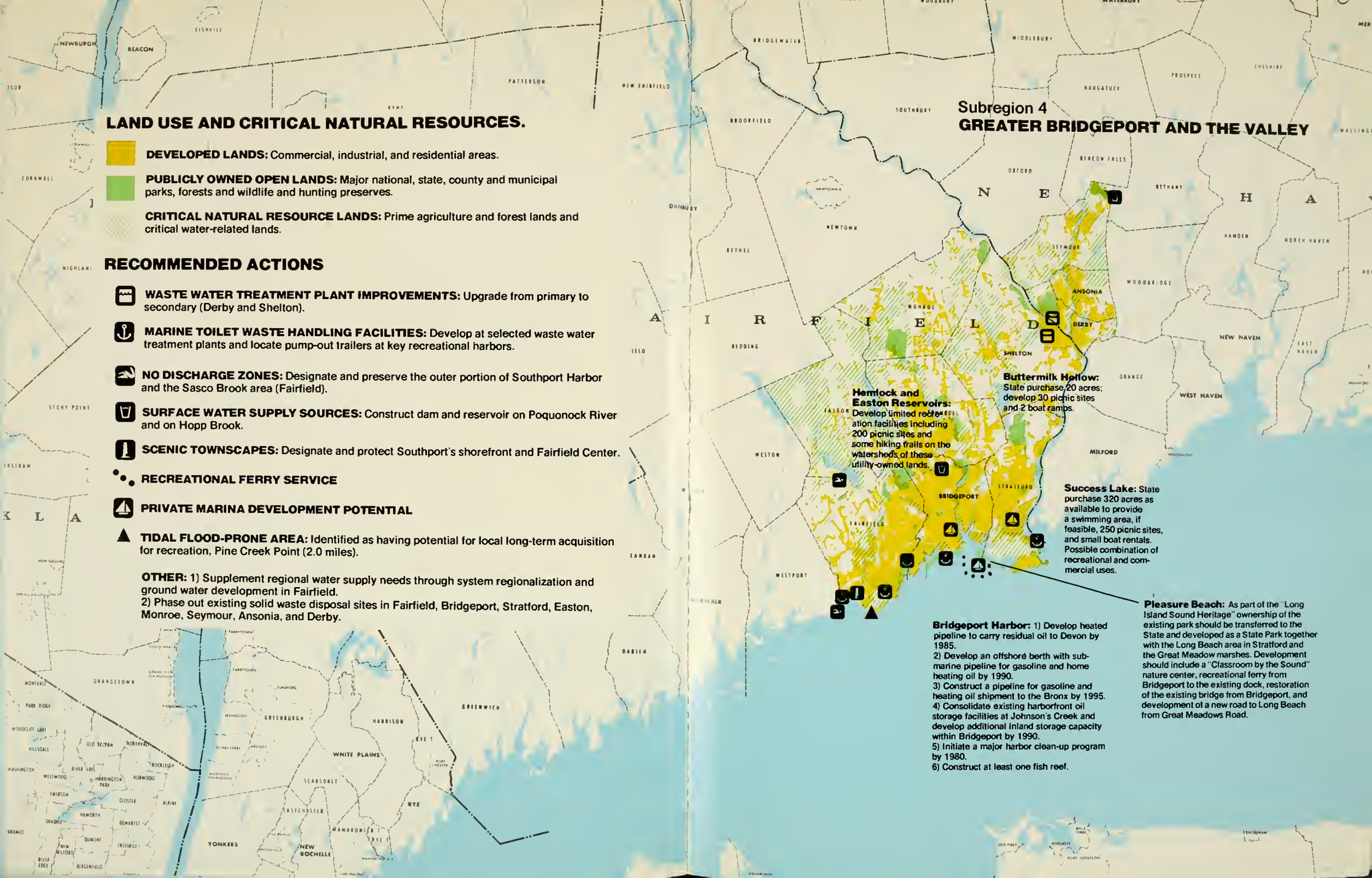
Lighthouse Point Park: As part of the "Long Island Sound Heritage," the State should purchase flood-prone lands along Shell Beach as they become available. Total development would include about 0.5 miles of beach, 500 picnic sites, and recreational ferry service from New Haven.

Stony Creek Quarry/Faulkner's Island: As part of the "Long Island Sound Heritage," the State should purchase both parcels by 1980, for casual recreational use. A small recreational ferry would provide access to the island. Development of both units could provide 300 picnic sites and 0.5 mile of beach.

Hammonasset State Park: State purchase additional 500 acres on east and west sides of River, including wetland area. Development to include 200 campsites, 200 picnic sites, expansion of existing nature center into "Classroom by the Sound," and hiking paths.

Silver Sands State Park: As part of the "Long Island Sound Heritage", the State should purchase Charles Island and additional flood-prone portions of Fort Trumbull Beach by 1980. Development could include boardwalk-fishing pier to island, about 2.0 miles beach, 500 picnic sites, and a small public marina.

New Haven Harbor: 1) Dredge channel to 40 feet, to receive large oil tankers by 1985.
2) Develop a heated pipeline to Middletown, to transport residual oil, by 1985.
3) Develop an offshore berth with submarine pipeline for gasoline and home heating oil by 1985, to operate in conjunction with pipeline to Hartford and Springfield, Mass.
4) Relocate ¾ existing harborfront oil storage tanks to inland sites.
5) Initiate major harbor debris clean-up program by 1980.
6) Develop year-round ferry service to Shoreham-Wading River area of Long Island.
7) Develop a public marina.
8) Construct a fishing pier (in the City Point area) and a fish reef.


LAND USE AND CRITICAL NATURAL RESOURCES.
DEVELOPED LANDS: Commercial, industrial, and residential areas.
PUBLICLY OWNED OPEN LANDS: Major national, state, county and municipal parks, forests and wildlife and hunting preserves.
CRITICAL NATURAL RESOURCE LANDS: Prime agriculture and forest lands and critical water-related lands.
RECOMMENDED ACTIONS
WASTE WATER TREATMENT PLANT IMPROVEMENTS: Upgrade from primary to secondary (Derby and Shelton).
MARINE TOILET WASTE HANDLING FACILITIES: Develop at selected waste water treatment plants and locate pump-out trailers at key recreational harbors.
NO DISCHARGE ZONES: Designate and preserve the outer portion of Southport Harbor and the Sasco Brook area (Fairfield).
SURFACE WATER SUPPLY SOURCES: Construct dam and reservoir on Poquonock River and on Hopp Brook.
SCENIC TOWNSCAPES: Designate and protect Southport's shorefront and Fairfield Center.
RECREATIONAL FERRY SERVICE
PRIVATE MARINA DEVELOPMENT POTENTIAL
TIDAL FLOOD-PRONE AREA: Identified as having potential for local long-term acquisition for recreation, Pine Creek Point (2.0 miles).
OTHER: 1) Supplement regional water supply needs through system regionalization and ground water development in Fairfield.
2) Phase out existing solid waste disposal sites in Fairfield, Bridgeport, Stratford, Easton, Monroe, Seymour, Ansonia, and Derby.
Subregion 4
GREATER BRIDGEPORT AND THE VALLEY
Hemlock and Easton Reservoirs: Develop limited recreation facilities including 200 picnic sites and some hiking trails on the watersheds of these utility-owned lands.
Buttermill Hollow: State purchase 20 acres; develop 30 picnic sites and 2 boat ramps.
Success Lake: State purchase 320 acres as available to provide a swimming area, if feasible, 250 picnic sites, and small boat rentals. Possible combination of recreational and commercial uses.
Pleasure Beach: As part of the "Long Island Sound Heritage" ownership of the existing park should be transferred to the State and developed as a State Park together with the Long Beach area in Stratford and the Great Meadow marshes. Development should include a "Classroom by the Sound" nature center, recreational ferry from Bridgeport to the existing dock, restoration of the existing bridge from Bridgeport, and development of a new road to Long Beach from Great Meadows Road.
Bridgeport Harbor: 1) Develop heated pipeline to carry residual oil to Devon by 1985.
2) Develop an offshore berth with submarine pipeline for gasoline and home heating oil by 1990.
3) Construct a pipeline for gasoline and heating oil shipment to the Bronx by 1995.
4) Consolidate existing harborfront oil storage facilities at Johnson's Creek and develop additional inland storage capacity within Bridgeport by 1990.
5) Initiate a major harbor clean-up program by 1980.
6) Construct at least one fish reef.
NEWBURGH
BEACON
PATTERSON
NEW FAIRFIELD
BRIDGEWATER
MIDDLEBURY
WATERBURY
SOUTHBURY
BROOKFIELD
DANBURY
NEWTOWN
BETHEL
REDDING
OXFORD
BETHANY
NAUGATUCK
PROSPECT
BEACON FALLS
SEYMOUR
ANSONIA
DERBY
SHELTON
WOODBRIDGE
HAMDEN
NORTH HAVEN
NEW HAVEN
EAST HAVEN
ORANGE
WEST HAVEN
MILFORD
WESTON
EASTON
FAIRFIELD
BRIDGEPORT
STRATFORD
WESTPORT
NORWALK
DARIEN
GREENWICH
STAMFORD
STONY POINT
ORANGETOWN
GREENBURGH
HARRISON
WHITE PLAINS
SCARSDALE
EASTCHESTER
RYE
YONKERS
NEW ROCHELLE
MAMARONECK
TARRYTOWN
IRVINGTON
HASTINGS ON HUDSON
DOBBS FERRY
TUCKAHOE
PORT CHESTER
MONTVALE
PARK RIDGE
WOODCLIFF LAKE
HILLSDALE
OLD TAPPAN
NORTHVALE
WASHINGTON
RIVER VALE
WESTWOOD
EMERSON
HAWORTH
ORADELL
DEMAREST
CLOSTER
ALPINE
NORWOOD
HARRINGTON PARK
ROCKLEIGH
DUMONT
CRESSKILL
NEW MILFORD
RIVER EDGE
BERGENFIELD

LAND USE AND CRITICAL NATURAL RESOURCES.

DEVELOPED LANDS: Commercial, industrial, and residential areas.

PUBLICLY OWNED OPEN LANDS: Major national, state, county and municipal parks, forests and wildlife and hunting preserves.

CRITICAL NATURAL RESOURCE LANDS: Prime agriculture and forest lands and critical water-related lands.

RECOMMENDED ACTIONS

ALTERATIONS TO WASTE WATER TREATMENT PLANTS: Upgrade from primary to secondary (Stamford), phase out existing facility (Darien).

MARINE TOILET WASTE HANDLING FACILITIES: Develop at selected waste water treatment plants and locate pump-out trailers at key recreational harbors.

NO DISCHARGE ZONES: Designate and preserve the water in the area of Norwalk Islands, in the Saugatuck River north of Westport, and at Scott Cove (Darien).

SURFACE WATER SUPPLY SOURCES: Enlarge Siscowit Reservoir, Comstock Brook Reservoir, and Mianus Reservoir; divert some of the stream flow of the Norwalk River.

RECREATIONAL FERRY SERVICE

BOAT LAUNCH LANES

PRIVATE MARINA DEVELOPMENT POTENTIAL

FLOOD CONTROL: Develop a flood control project (including a dam, stream channelization and land treatment) on the Norwalk River; study structural and non-structural abatement measures at Compo Beach.

OTHER: 1) Supplement regional water supply needs through system regionalization and ground water development in Stamford, Darien, and Westport.
2) Phase out existing solid waste disposal sites in Wilton, Darien, New Canaan, Weston, and Greenwich.

Subregion 5
SOUTHWESTERN CONNECTICUT

Saugatuck Reservoir: Develop limited recreation facilities including 300 picnic sites on the watershed of this utility-owned land. (Outside but adjacent to region.)

Sherwood Island State Park: As part of the "Long Island Sound Heritage," the State should purchase the flood-prone properties immediately to the west, by 1980. Development should include 500 picnic sites and 4 boat ramps.

Calf Pasture Beach: Construct a fishing pier.

Manresa Island: Develop one or more boat launch lanes.

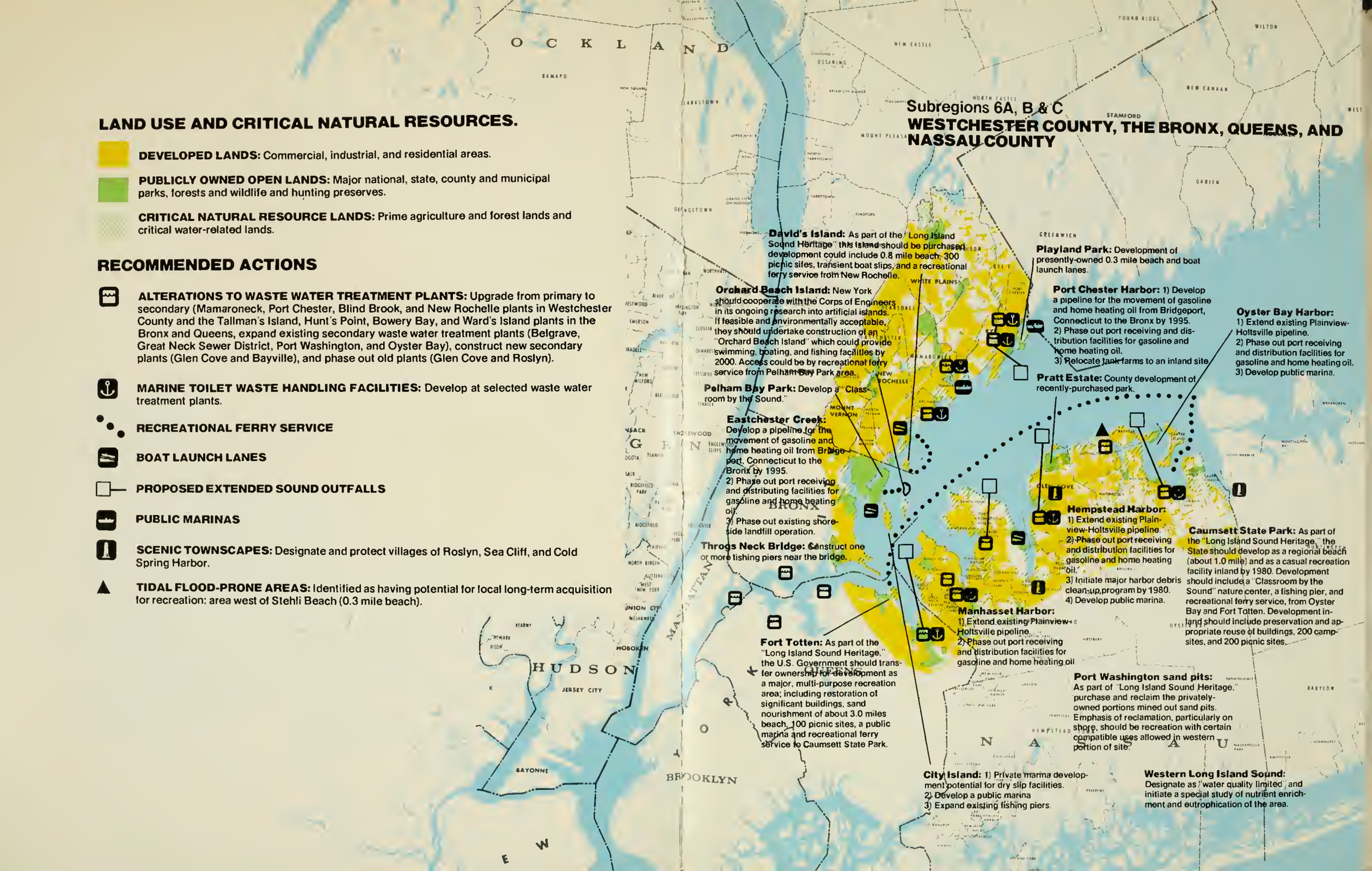
Norwalk archipelago: Designate and preserve as a special scenic zone.

Chimon Island: As part of the "Long Island Sound Heritage," this island should be purchased as a wildlife management — nature observation area.

Shea Island: Develop a "Classroom by the Sound" nature center.

Sheffield Island: As part of the "Long Island Sound Heritage," this island should be purchased immediately as a general recreation area including swimming beach, fishing piers, and recreational ferry from Norwalk.

Norwalk and Stamford Harbors:
1) Construct a pipeline for gasoline and home heating oil shipment from Bridgeport, Connecticut to the Bronx by 1995.
2) Phase out existing port receiving and distribution facilities for gasoline and heating oil.
3) Relocate all oil storage tank farms, except those used for residual oil, to inland sites adjacent to the pipeline.
4) Initiate major harbor clean-up programs by 1980.
5) Develop public marinas.


Subregions 6A, B & C
WESTCHESTER COUNTY, THE BRONX, QUEENS, AND NASSAU COUNTY
LAND USE AND CRITICAL NATURAL RESOURCES.
DEVELOPED LANDS: Commercial, industrial, and residential areas.
PUBLICLY OWNED OPEN LANDS: Major national, state, county and municipal parks, forests and wildlife and hunting preserves.
CRITICAL NATURAL RESOURCE LANDS: Prime agriculture and forest lands and critical water-related lands.
RECOMMENDED ACTIONS
ALTERATIONS TO WASTE WATER TREATMENT PLANTS: Upgrade from primary to secondary (Mamaroneck, Port Chester, Blind Brook, and New Rochelle plants in Westchester County and the Tallman's Island, Hunt's Point, Bowery Bay, and Ward's Island plants in the Bronx and Queens, expand existing secondary waste water treatment plants (Belgrave, Great Neck Sewer District, Port Washington, and Oyster Bay), construct new secondary plants (Glen Cove and Bayville), and phase out old plants (Glen Cove and Roslyn).
MARINE TOILET WASTE HANDLING FACILITIES: Develop at selected waste water treatment plants.
RECREATIONAL FERRY SERVICE
BOAT LAUNCH LANES
PROPOSED EXTENDED SOUND OUTFALLS
PUBLIC MARINAS
SCENIC TOWNSCAPES: Designate and protect villages of Roslyn, Sea Cliff, and Cold Spring Harbor.
TIDAL FLOOD-PRONE AREAS: Identified as having potential for local long-term acquisition for recreation: area west of Stehli Beach (0.3 mile beach).
David's Island: As part of the "Long Island Sound Heritage" this island should be purchased. development could include 0.8 mile beach, 300 picnic sites, transient boat slips, and a recreational ferry service from New Rochelle.
Orchard Beach Island: New York should cooperate with the Corps of Engineers in its ongoing research into artificial islands. If feasible and environmentally acceptable, they should undertake construction of an "Orchard Beach Island" which could provide swimming, boating, and fishing facilities by 2000. Access could be by recreational ferry service from Pelham Bay Park area.
Pelham Bay Park: Develop a "Classroom by the Sound."
Eastchester Creek: Develop a pipeline for the movement of gasoline and home heating oil from Bridgeport, Connecticut to the Bronx by 1995. 2) Phase out port receiving and distributing facilities for gasoline and home heating oil. 3) Phase out existing shoreside landfill operation.
Throgs Neck Bridge: Construct one or more fishing piers near the bridge.
Fort Totten: As part of the "Long Island Sound Heritage," the U.S. Government should transfer ownership for development as a major, multi-purpose recreation area; including restoration of significant buildings, sand nourishment of about 3.0 miles beach, 100 picnic sites, a public marina and recreational ferry service to Caumsett State Park.
Playland Park: Development of presently-owned 0.3 mile beach and boat launch lanes.
Port Chester Harbor: 1) Develop a pipeline for the movement of gasoline and home heating oil from Bridgeport, Connecticut to the Bronx by 1995. 2) Phase out port receiving and distribution facilities for gasoline and home heating oil. 3) Relocate tank farms to an inland site.
Pratt Estate: County development of recently-purchased park.
Oyster Bay Harbor: 1) Extend existing Plainview-Holtsville pipeline. 2) Phase out port receiving and distribution facilities for gasoline and home heating oil. 3) Develop public marina.
Hempstead Harbor: 1) Extend existing Plainview-Holtsville pipeline. 2) Phase out port receiving and distribution facilities for gasoline and home heating oil. 3) Initiate major harbor debris clean-up program by 1980. 4) Develop public marina.
Manhasset Harbor: 1) Extend existing Plainview-Holtsville pipeline. 2) Phase out port receiving and distribution facilities for gasoline and home heating oil
Caumsett State Park: As part of the "Long Island Sound Heritage," the State should develop as a regional beach (about 1.0 mile) and as a casual recreation facility inland by 1980. Development should include a "Classroom by the Sound" nature center, a fishing pier, and recreational ferry service, from Oyster Bay and Fort Totten. Development inland should include preservation and appropriate reuse of buildings, 200 campsites, and 200 picnic sites.
Port Washington sand pits: As part of "Long Island Sound Heritage," purchase and reclaim the privately-owned portions mined out sand pits. Emphasis of reclamation, particularly on shore, should be recreation with certain compatible uses allowed in western portion of site.
City Island: 1) Private marina development potential for dry slip facilities. 2) Develop a public marina 3) Expand existing fishing piers.
Western Long Island Sound: Designate as "water quality limited" and initiate a special study of nutrient enrichment and eutrophication of the area.
HUDSON
BROOKLYN
BRONX
MANHATTAN
QUEENS
NASSAU
HOBOKEN
JERSEY CITY
BAYONNE
NEW ROCHELLE
MOUNT VERNON
WHITE PLAINS
GREENWICH
STAMFORD
NEW CANAAN
DARIEN
WILTON
RYE
LONG ISLAND

Subregion 7, 8 & 9
SUFFOLK COUNTY

LAND USE AND CRITICAL NATURAL RESOURCES.

DEVELOPED LANDS: Commercial, industrial, and residential areas.

PUBLICLY OWNED OPEN LANDS: Major national, state, county and municipal parks, forests and wildlife and hunting preserves.

CRITICAL NATURAL RESOURCE LANDS: Prime agriculture and forest lands and critical water-related lands.

RECOMMENDED ACTIONS

WASTE WATER TREATMENT PLANT IMPROVEMENTS: Expand existing secondary plants (Northport, Port Jefferson, and Smithtown) and construct new secondary plants (Westplant, and Eastplant, Southold; and Elizabeth Field, Fishers Island).

MARINE TOILET WASTE HANDLING FACILITIES: Develop at selected waste water treatment plants.

SCENIC TOWNSCAPES: Designate and protect villages of Cold Spring Harbor, Northport, Head of the Harbor, and Greenport Village.

RECREATIONAL FERRY SERVICE

TIDAL FLOOD-PRONE AREAS: Identified as having potential for local long-term acquisition for recreation. Asharoken (1.7 miles), West Meadow (1.1 miles), Mt. Sinai (0.5 mile), Wading River (0.6 mile), and Truman Beach (1.0 mile).

PROPOSED EXTENDED SOUND OUTFALL

PRIVATE MARINA DEVELOPMENT POTENTIAL

Eaton's Neck-Nissequogue: Designate and preserve portions of this area as special scenic zones.

Huntington Harbor: 1) Phase out existing port petroleum receiving and distributing facilities.
2) Potential for private marina development.
3) Develop a public marina.

Shoreham/Wading River: Develop a year-round ferry service to New Haven.

Wildwood State Park: Develop a "Classroom by the Sound" nature center and fishing piers.

Smithtown Bay:
1) Develop a public marina.
2) Construct a fish reef.

Mt. Sinai Harbor: Designate and preserve as a no-discharge water quality zone.

Caumsett State Park: As part of the "Long Island Sound Heritage," the State should develop as a regional beach (1.0 mile) and as a casual recreation facility inland by 1980. Development should include a "Classroom by the Sound" nature center, a fishing pier, and recreational ferry service from Oyster Bay and Fort Totten. Development inland should include the preservation and appropriate reuse of buildings, 200 campsites and 200 picnic sites.

Sunken Meadow State Park: Develop a "Classroom by the Sound" nature center and a fishing pier.

Plainview-Holtsville Pipeline: Extend existing pipeline east to Northville and west to mid-Nassau by 1980.

Port Jefferson Harbor:
1) Develop an offshore terminal for receipt of gasoline and home heating oil by 1985, with a submarine pipeline to an inland tank farm and Plainview-Holtsville pipeline.
2) Develop recreational ferry to sand spits (County park) at Harbor's mouth.
3) Develop a public marina.
4) Potential for private marina development.
5) Develop an artificial fish reef.

Roanoke Point: As part of the "Long Island Sound Heritage," purchase about 450 acres of beach bluff, and woodlands as casual recreation/scenic preservation area. Limited development on inland portions for picnicking and related activities. Access to beach and bluff area limited to one or two pedestrian access points.

North Shore Bluffs: Designate as an "area of particular concern by the proposed state coastal zone management entity and preserve as a special scenic zone.

St. Thomas/Dam Pond Area: Purchase about 300 acres of bluff, beach, woodland and pond as scenic preservation — casual recreation area. Limited development of inland portion for recreation and related activities. Limited pedestrian access to beach and bluff area.

Mattituck Inlet: Phase out port petroleum receiving and distributing facilities.

Greenport Harbor: Develop a public marina.

Southeastern Connecticut Subregion 1

The Setting

Only partially shielded by Montauk Point some twenty-five miles south, the 79-mile coastline of Subregion 1 is the most exposed of any in the Long Island Sound region. It is characterized by an irregular coastline with numerous bays, coves, and promontories, and a number of small islands. Narrow, sandy, and often stony beaches backed with few small dunes make up about twenty-five miles of the shoreline. The balance consists either of rocky shore or wetlands, the latter found principally in the eastern half of the subregion. The approximately 800-square-mile land area is drained by many small parallel streams flowing southward to the Sound and by one major river system, the Thames. The estuary of this river extends approximately fifteen miles inland to Norwich. There are a number of cultural and historic attractions in this area, including Mystic Seaport, one of the most popular tourists attractions in the Northeast, Stonington Borough's little-changed eighteenth century fishing port, and Yantic Leap in Norwich.

Although still lightly settled with a density of about 400 people per square mile, the Southeastern Connecticut subregion is growing at a rate almost twice that of the nation and slightly faster than the state. Continued growth is expected in the relatively densely populated urban core along the Thames River from Norwich to the estuary towns of Groton and New London. However, the most significant growth pressures during the next few decades are anticipated in the largely undeveloped suburban and rural towns. According to the most recent census figures, the population in this area rose from about 179,000 in 1960 to 220,000 in 1970, an increase of some 23 percent. It is expected to reach 274,000 by 1990 and 333,000 by 2020. These projections represent a very sharp decrease in the annual growth rate, from about 2.2 percent average annual compound rate to 0.7 percent.

Significant coastal and water-related activities in this subregion include major Navy and Coast Guard installations, shipbuilding, recreation, summer vacationing, tourism, electric power production, industrial and municipal waste disposal, a naval and petroleum products port, some commercial fishing activities, and a ferry terminus for the Block Island, Fisher's Island, and Orient Point ferries.

Major Coastal Problems

The major coastal problems include improving local water quality, especially in the Thames Estuary, improving the safety and efficiency of the existing marine transportation system, protecting the shoreline from haphazard development, meeting the regional and extra-regional needs for recreation facilities, and meeting anticipated regional needs for electric power in environmentally acceptable ways.

Improvement of Water Quality

Water quality, although generally good along the coast, suffers from a number of chronic pollution sources, particularly along the Thames River estuary. These include inadequately treated municipal waste water, industrial processing contaminants, and combined sewer/storm water overflows. Connecticut's Department of Environmental Protection and municipalities, with the financial and technical assistance of the U.S. Environmental Protection Agency, have made significant strides over the past decade toward abating both municipal waste water and industrial pollution. Stonington provides a particularly good example of the agressive partnership of federal, state, and local interest in abating these problems. The state's emphasis in this subregion has been to encourage system regionalization and secondary treatment for the former source and pretreatment before municipal facility processing for the latter. These new facilities are being designed to accommodate the anticipated growth here.

Even after these measures are fully operational, however, it appears that there still will be a significant water quality problem in the Thames River estuary. This is because of the nature and extent of both point and non-point pollution sources, including untreated waste water from naval ships in the River, oily bilge water discharge, solids, nutrients, and

bacteria from combined sewer/storm water overflows into the estuary from Norwich, and leachates from solid waste disposal areas on the shore and adjacent to streams inland.

Connecticut, together with the communities bordering the Thames River, should develop an areawide water management ("208") program by 1976. The program would become the vehicle for the integration of land use and water quality management, as well as the implementation of proposed water quality restoration programs.

The study also recommends the following specific actions to achieve fishable-swimmable waters in the Thames River estuary by 1990:

- Prompt compliance by all U.S. Naval vessels with guidelines for ship discharge of waste material, as set forth in the Navy 5-year plan for reorganization and restructuring of the Groton Naval base, in line with Coast Guard and Environmental Protection agency rules. This will include connection of the base collection system to the new Groton secondary treatment plant and construction of pier sewers.
- Continued evaluation by the Connecticut Department of Environmental Protection and the city of Norwich of the efficacy of sewer separation as a means of controlling storm water overflows. Alternatives include overflow storage and treatment, secondary treatment plant expansion, and computer-operated system-wide diversion and storage.
- Application of accepted land management practices along the drainage shed of the Thames basin to abate urban runoff.
- Contingent upon the development of federal guidelines, the study has identified the potential for permanent marine toilet pump out facilities to include landing piers, a pump out device, and appropriate pretreatment facilities, at waste water treatment plants at New London, Groton, and Stonington Borough. The study has also identified the opportunity for mobile pump out trailers at or near the Niantic River, Thames River/New London, Mystic River, and Stonington Harbor.
- Many of the towns in the subregion have unsatisfactory solid waste disposal areas which affect water quality. These are located in Groton, New London, Bozrah, Ledyard, Montville, and Waterford. The study urges the state to speedily implement its *Proposed Connecticut Solid Waste Management Plan*, which would have much of the solid waste from this region transferred to a major recovery facility in Southeastern Connecticut. All solid waste disposal areas could thereby be rendered safe to water quality by 1990.
- State and local implementation of the study's recommendations for port consolidation and coastal zone management. The former is outlined briefly below. All of these actions are discussed in greater depth in Section Two: The Plan by Major Subject.

Perhaps as important as the restoration of polluted waters is the preservation of existing high quality waters. To this end, the study recommends the designation of a number of relatively pristine streams and estuarine areas as non-degradation zones (which prohibit both additional point and most non-point sources of pollution) in order to preserve fish, shellfish, and recreational waters. Examples include: the area between Baker's and Andrew's Island in Mystic; Jordan Cove in Waterford; Niantic Bay; and the Poquonock River. In other areas throughout the subregion, the study would urge government officials to protect high water quality areas by severely restricting the development of critical water-related lands such as flood plains, wetlands, and erosion-prone areas.

Marine Transportation System Improvements

New London Harbor and the Thames River are significant ports in the subregion. New London currently handles about 4 million tons of product a year, mostly petroleum, with residual oil representing about 90 percent of the vessel traffic into the harbor. Of this, some 60 percent or 8.6 million barrels are in turn transshipped by barge to Middletown and Hartford on the Connecticut River.

The study recommends instead that this oil be shipped to New Haven Harbor, where it would be sent by a heated pipeline to the major users (primarily power plants) at Middletown, by 1985. This would substantially reduce the commercial traffic in New London Harbor and the need for storage equipment there. In addition, it would end oil barge traffic from Groton down the coast and up the Connecticut River. Some residual oil would continue to be shipped to facilities at Groton and barged up the Thames River to Montville.

The study also recommends continued barging of gas and distillate to commercial and military terminals along the Thames River, as this current system appears to be the most cost-effective method of refined product transport and represents no particularly extreme environmental threat so long as proper safeguards are utilized. (See Section 2.1 Water Management.)

Also considered was the development of an offshore unloading berth. This was rejected due to high costs for relatively low product volumes.

In addition, the study recommends the development of an inland tank farm of about twelve acres in the Norwich area by 1990. This facility would store about 600,000 barrels of petroleum products which would be supplied by barge from Groton.

Other commercial traffic for bulk and general cargoes is expected to continue in New London Harbor. Sand and gravel shipments, in particular, are likely to increase as this subregion starts exporting increased volumes in the next few decades to deficient subregions to the west.

Shoreline Protection

Rather than develop a detailed shoreline plan for each of its nine subregions, the study has attempted to set forth in Section Four: Carrying Out the Plan, a legal and institutional framework for effective local and regional management of the coastal zone throughout the Long Island Sound region. Its provisions would have each locality develop a plan for its coastal zone, working closely with appropriate regional and state officials. Under this proposed arrangement, there are a number of tools specified for each of the different levels of government to insure the wise management of the entire coastline of the Sound. Subregion 1 has also been selected as the location for Connecticut's pilot project in coastal zone management.

There are a number of specific policy, conservation, and development recommendations the study has made which would represent a significant first step toward the development of a plan for the coastal zone of the Southeastern Connecticut Region. These proposals are shown in the Map Folio preceding this section and include:

- Designation of Stonington Borough, North Stonington, Mystic Center, and parts of Norwich as scenic townscapes.
- Designation and preservation of selected areas of the Connecticut shore and upper shorelands east of New London to the Rhode Island border. Means of preservation should include the use of proposed state environmental bond funds, federal Land and Water Conservation Act funds and appropriate local tax incentives and zoning.
- Prompt phasing out of shore and stream bank solid waste disposal areas in Groton, New London, Bozrah, Ledyard, Montville, and Waterford.
- State acquisition and/or development of the following sites for recreation or conservation: Bluff Point State Park, Bride Lake near Rocky Neck State Park, the proposed Mohegan-Pequot State Park on the Thames, and Ram, Dodges and Andrews Islands.

Future Recreation Needs

Large anticipated increases in this subregion's recreation demand—for guarded public beach, picnic grounds, boating facilities, and especially camping grounds—are fanned by population growth and affluence, as well as the large influx of summer visitors. Southeastern Connecticut has more open space (90 percent) than any of the other subregions—about 60 percent in forests, with the remainder primarily in agriculture, residential area, and wetlands. In addition to the selected recreation acquisitions shown in the Map Folio, the study would urge local and state governments to examine additional acquisition and regulation opportunities in areas of key open space potential.

The principle focus of this study, though, is the shoreline: seventy-nine miles of rocky, irregular coast, of which only thirteen are in public ownership. It should be noted, however, that of this land in public ownership, only a small fraction is available to the general public for beach swimming. There are presently only two shorefront beaches in Subregion 1 for the general public: Rocky Neck State Park in East Lyme and Ocean Beach in New London. Also situated within this subregion, but not now available to the public, are the Bluff Point State Park, presently undeveloped, and Harkness Memorial State Park, a facility restricted for use by the handicapped.

The study has identified a number of opportunities for the development of new regional beaches in this subregion:

- **Bluff Point State Park** should be developed by the state by 1977 to serve two simultaneous objectives: the southeastern portion could serve as a swimming beach in conjunction with Ram Island (see below); while the western and interior portions would serve as a more casual recreation resource for picnicking and nature walks, reflecting the fragile nature of this land. The eroding sandy strip to the west should be retained in its undeveloped state and carefully managed for use in conjunction with the more extensive western portion of the area. Development on the southeastern shore might include about one-half mile of beach, while development inland should include an interpretive nature center, walking trails, and about 500 picnic sites.
- **Ram Island** in the Mystic Island group should be acquired by the state by 1980 as part of the Long Island Sound Heritage. A ferry service from Bluff Point State Park would serve Ram Island, an adjunct to that park. Development here could provide at least one-half mile of beach.
- **Rocky Neck State Park** in East Lyme should be expanded by the annexation of undeveloped portions of the soon-to-be abandoned Niantic State Farm for Women. This 850 acre tract includes prime natural areas, Bride Lake, and a significant freshwater marsh. Buildings on the site should be put to some appropriate re-use, while development of the open land should take place by 1985 and could include about 400 campsites. State construction of an erosion control structure at the mouth of Bride Brook should result in the natural restoration of about 0.6 mile of beach.
- Portions of shoreline at **Bluff Point State Park, Rocky Neck State Park, Ocean Beach,** and **Ram Island** should be nourished with sandfill where feasible and appropriate to increase beach width to an average of 300 feet.

In addition to these shorefront parks, the study has identified a number of acquisition and development opportunities which would help to deflect some of the demand inland. They include:

- State acquisition of 800 additional acres at **Hopemead State Park** in Bozrah, with development to include a swimming area, 500 picnic sites, and about

200 campsites.

- State acquisition of 700 acres at **Pachaug Pond** in Griswold and 450 acres at **Beach Pond** in Voluntown to provide a swimming area, 500 picnic sites, and about 200 campsites at each location.
- Expansions of **Hopeville Pond State Park** (90 acres) and the proposed **Mohegan-Pequot State Park** (350 acres) which should include 600 picnic sites total. (Mohegan-Pequot State Park would be made up of existing state holdings, including Fort Shantok and Stoddard Hill State Parks).
- State acquisition of 2200 acres at **Susquehanna Plains** in Franklin and Sprague for development as a state park to include 250 picnic sites, 100 campsites, and some limited boating and canoeing on the Shetucket River.
- State acquisition of 900 acres around and including **Powers Lake** in East Lyme, if and as it becomes available from the Yale University Sheffield School of Engineering, to include development of 100 picnic sites and boating facilities.
- State acquisition of an additional 235 acres around and including **Green Fall Pond** in Voluntown, and development of a small state park to include 100 picnic sites, a swimming area, and one boat launch ramp.

There is a serious deficiency of boat ramps in Subregion 1 to meet individual needs. Although some potential exists for an increase in the number of marinas, this shoreline area is becoming highly urbanized, and projected boating demand far exceeds recommended development of facilities. Private potential for development of slips and or moorings exists within Mystic Harbor in Stonington and on the Niantic River in Waterford (25 acres). Intensive Development of these and other facilities could provide wet storage berths for as many as 1000 boats. In addition, private development of dry slip facilities at New London and Niantic could provide storage for about another 1000 boats. It should be noted that these are just *potentials*, they are not necessarily recommended by the Sound Study. Detailed small boat harbor studies for each of the Sound's recreational harbors, coves, and embayments should be developed, balancing the need to protect some particularly sensitive areas with the growing demands for boat storage and use. (See Section 2.3 Outdoor Recreation.)

The study recommends development of a public marina facility, including boat rentals, limited slips and moorings, ramps, and a launch service in New London Harbor. It is also recommended that the state develop boat launch lanes and attendant parking facilities at Bartlett Cove in Montville, Long Rock in Preston, and Barn Island Hunting area in Stonington.

In addition to the Bluff Point, Ram Island, Rocky Neck, and Hatchett Point proposals, the study recommends state acquisition of Dodges and Andrews Islands off Mystic for inclusion in the Long Island Sound Heritage. The islands should be devoted to wildlife management. To increase public access to the Sound for fishing, it is recommended that the town of New London consider development of fishing piers at Ocean Beach.

Future needs for adequate electric power

The study has not made site-specific recommendations for future power plant development, since each new facility is subject to detailed review and evaluation requirements well beyond the scope of the study. It has instead outlined a series of policy recommendations to ensure the safe provision of this form of energy for the future. In addition, some potential sites for future generating facilities have been identified. These require much more detailed review by the state and federal licensing procedure.

Southeastern Connecticut has a number of potential sites including possible expansion at Millstone Point and Montville. If the study's recommended conservation techniques are fully utilized, additional development may be postponed until more environmentally suitable or publicly acceptable forms of generation are available.

Other Issues

There are a number of other, less critical issues that the study has examined in Southeastern Connecticut.

Water supply problems are minimal and local in this water-plentiful region. Most area residents are served by public utilities. The three major water systems—at New London, Groton, and the largest single system at Norwich—are supplied primarily by surface water reservoirs. Away from these urban centers, there are many small public systems. Also, many of the residents in these areas rely on individual sources of supply. The study recommends that local shortages can best be avoided by consolidation of very small water supply systems when economically feasible, in cooperation with the Southeastern Connecticut Water Authority, and by new sources, through ground water development projects, which would provide 8.5 million gallons per day (MGD) by 1990, and 10.0 MGD by 2020, at costs of $5 million and $6 million respectively, in the towns of Bozrah, Colchester, Franklin, East Lyme, Griswold, Lisbon, Stonington, North Stonington, Salem, Sprague, and Voluntown. Also, development of the Joe Clark Brook Reservoir in combination with the Shewville Brook diversion during the 1990-2020 period will provide 9.5 MGD at a cost of $8.3 million.

Flood damages presently amount to $3.3 million annually in the region. However, a recurrence of the 1938 hurricanne could cause $30 million tidal flooding damage and as much as $90 million in 2020. Riverine flooding damages from a 100-year frequency storm would amount to $11.2 million. The tidal flooding damages are scattered throughout the region, with the Stonington, Mystic, New London, and Thamesville areas suffering the greatest

amounts. Flood plain management measures should reduce projected future damages by about 25 percent. The Yantic River flood control project, including a dam, land treatment, and channelization, is the only structural solution recommended. Also recommended is the study of alternative solutions to tidal flood threats at Thamesville and Montville. Such alternatives might include floodproofing, flood plain zoning, and relocation of development in the flood plain as well as some structures.

Coastal erosion damages presently amount to $220,000 annually, and could increase to $330,000 annually by 1990 and $660,000 by 2020. Through the state program of annual maintenance of existing beach erosion control structures and adoption of suitable land use regulations in erosion prone communities, these damages can be reduced by about 36 percent. The study has concluded that the rest of the damages are beyond practical reduction in environmentally and economically acceptable ways.

Upland erosion and sedimentation damages amounted to $1.7 million in 1970, with the most significant losses coming from untreated croplands, construction sites, roadbanks, and streambanks. Future damages can be reduced by an estimated 58 percent through: 1) urban non-structural measures involving construction site selection and planning and retention of vegetative cover; 2) structural and non-structural measures for agricultural and forest lands; and 3) state program to control roadbank erosion on existing and new highways.

Connecticut River Estuary Subregion 2

The Setting

The Connecticut River Estuary Region is composed of nine small towns: Clinton, Westbrook, Old Saybrook, Old Lyme, Lyme, Essex, Deep River, Chester, and Killingworth. They cover 120,000 acres of largely rural land, part of Connecticut's Green Triangle. The Connecticut River is one of the largest rivers in the United States without a major city at its mouth. It is also the most important river entering the Sound for anadromous fishes, such as American shad and alewife. It is the focus of Atlantic salmon restoration, and is the only area where the endangered and protected Atlantic and Shortnosed sturgeon occur. The subregion includes approximately thirty-two miles of riverfront and thirty-one miles of Long Island Sound shoreline. Eight of the nine towns are bounded either by Long Island Sound or the Connecticut River or both. The estuary is blessed with 5,600 acres of salt marsh and numerous intimate and largely undeveloped coves and inlets. Major cultural attractions in the region include the Gillette Castle, the historic village of Essex, and the Chester-Hadlyme Ferry, which has been in operation since 1759.

The Connecticut Estuary population jumped 60 percent between 1960 and 1970, from 27,000 to 43,000, increasing faster than any other region in the state. Much of this growth took place in or near the coastal sections of the region's towns, some stemming from the conversion of seasonal housing units along the Sound's shore to year-round homes. As shorefront land becomes increasingly scarce, it is anticipated that much of the region's future growth will take place in the undeveloped uplands of the region. It is projected that this area's population will increase to about 78,000 by 1990 and 106,000 by 2020. In accordance with expected regional, state, and national population trends, these projections represent a significant decrease in the annual growth rate, from about 2.6 percent average annual compound rate to 1 percent.

The principal coastal activities of this region are swimming, boating, hiking, and tourism, to name a few.

Some commercial shipping takes place upon the Connecticut River, particularly petroleum products destined for Hartford or Middletown. Much of the Sound's and some of the river's shoreline is devoted to seasonal residences, private beaches, and marina development.

Major Coastal Problems

The major coastal problems in Subregion 2 include protection of the shoreline, particularly along the river, from any deterioration which might result from growth in either population or tourism; improvement of the water quality, particularly in the Estuary, to swimmable-fishable standards; improving the safety and efficiency of the present system of transporting petroleum products along the coast and up the river by barge; and meeting future demands for recreation facilities without destroying the very ambiance which draws the public in the first place.

Shoreline Protection

Unlike any other subregion within the study area, Subregion 2—at least that group of towns bounded by the Connecticut River—is fortunate to have some degree of shorefront protection and enhancement provided by virtue of the recent ratification of the Gateway Compact. Its intent is to preserve the beauty of the local landscape through land use standards or through acquisition of scenic easements and development rights on key areas along the river. For those towns which do not belong to the Compact, and perhaps even for those which do, there should be significant interest in the study's recommendation regarding the management of the coastal zone.

Rather than develop a detailed shoreline plan for each of its nine subregions, the study has set forth in Section Four: Carrying Out the Plan a legal and institutional framework for effective local and regional management of the coastal zone throughout the Long Island Sound region. Its provisions would have each locality, working closely with appropriate regional and state officials, develop a plan for its coastal zone. Under this proposed arrangement, there are

a number of tools specified for each of the different levels of government to insure the wise management of the entire coastline of the Sound.

There are a number of specific policy, conservation, and development recommendations the study has made which would represent a significant first step toward the development of a plan for the coastal zone of the Connecticut River Estuary subregion. These proposals are discussed in detail throughout this chapter and are summarized in the Map Folio preceding this section. They include:

- Designation and preservation of selected areas, particularly the ridges, valleys and town centers, of the Green Triangle, an area running between Branford, Old Lyme, and Middletown. Means of preservation should include the use of proposed state environmental bond funds, federal Land and Water Conservation Act funds, and appropriate local tax incentives and zoning.
- Designation of the following areas, all of which are historically and architecturally significant, as protected townscapes: Essex Center, Chester Center, Lyme Street in Old Lyme, the Saybrook Point area of Old Saybrook, Clinton Center, and Hadlyme.
- Prompt phasing out of shore-and stream-side solid waste disposal areas in Old Saybrook, Westbrook, Chester, Deep River, Essex, and Clinton.
- Acquisition and/or development of the following sites for recreation or preservation: Eustasia Island in Lyme, Hatchett Point in Old Lyme, and the proposed expansion of Hammonasset State Park with the development of some linkage, such as a walking path, along the Hammonasset River.
- Local designation and long-term relocation of development from selected flood-prone areas along the shoreline. These might include floodable structures in the areas of Plum Bank and Great Hammock Beaches in Old Saybrook, Sound View in Old Lyme, Cedar Island in Clinton, and Duck Island Roads in Clinton and Westbrook.

Improvement of Water Quality

Some recreational activities—swimming and shellfishing—are presently denied in some of the region's waters due to water pollution. The major sources of pollution in the Connecticut River are upstream municipal and industrial facilities. It is anticipated, however, that most of these sources of pollution will have been abated over the next few years as upstream treatment facilities continue to be upgraded. By 1980, the estuary of the Connecticut River should again be swimmable.

Several new regional secondary municipal treatment plants, serving parts of Chester, Deep River, Clinton, Westbrook, Old Saybrook, Essex and Madison, should help to insure the continued improvement of water quality in the region. The plants will cost about $5 million and should be in operation by 1985.

While not a major source of pollution at the moment, pleasure boat waste discharges on the Connecticut River will represent an increasingly unpleasant source of sewage as the number of such craft increases and other sources of water pollution are abated. Therefore, contingent upon the development of federal guidelines, the study has identified the potential for permanent marine toilet pump out facilities, to include landing piers, a pump out device, and appropriate pretreatment facilities at the proposed Chester-Deep River secondary waste water treatment facility and whatever new downstream facility is developed. The study has also identified the opportunity for mobile pumpout trailers in Clinton Harbor, Westbrook Harbor, Saybrook Point, Essex, and Chester.

As the water quality improves in this lower section of the Connecticut River and along the shoreline of the Sound, leachates from shoreside and inland solid waste disposal areas, if not checked, could become an increasingly significant portion of the total loading on this section of the river. The study, therefore, urges the state to speedily implement its *Proposed Connecticut Solid Waste Management Plan*, which would have much of the solid waste of this region transferred to a major recovery facility in Southeastern Connecticut. Affected would be the existing solid waste disposal areas in Chester, Essex, Westbrook, Clinton, Old Saybrook, and Deep River.

Perhaps as important as the restoration of polluted waters is the preservation of existing high quality waters. To this end, the study recommends the designation of a number of relatively pristine streams and estuarine areas as non-degradation zones, which prohibit both additional point and most non-point sources of pollution, in order to preserve fish, shellfish, and recreational waters. Examples include Hammonasset River from the lake to the Sound and an area along the Fenwick shore in Old Saybrook. In other areas throughout the subregion, the study urges government officials to protect high water quality areas by severely restricting the development of critical water-related lands such as flood plains, wetlands, and erosion-prone areas.

Marine Transportation System Improvements

Another major potential source of pollution is oil spills from the hundreds of barges which travel up the Connecticut River each year. The study recommends phasing out the use of the river by oil laden barges* by making New Haven, in Subregion 3, Connecticut's major port for the receipt and distribution of refined petroleum products. Gasoline and home heating oil, presently barged upriver as far as Hartford, would instead be piped through the existing pipeline from New Haven to Hartford, while residual oil would be sent by a heated pipeline from New Haven to the

*The effect of this recommendation is to amend the NERBC 1980 Connecticut River Basin Plan.

major users, primarily power plants, at Middletown, by 1985. Although the demand for residual oil is not expected to increase substantially, it appears that current volumes alone could more economically be handled by hot line than by the present system of distribution—barge shipping from Groton over to and up the Connecticut River to Middletown and Hartford. There are also major environmental benefits to the development of a hot line. Along with full utilization of the existing clean line to Hartford, phasing-out of all oil barge traffic on the Connecticut River will eliminate the need for constant dredging to maintain the fifteen-foot channel. Until this port consolidation plan is implemented, the study recommends that the state require oil spill containment equipment to be available at a lower Connecticut River town, Essex or Old Saybrook, for example, in the event of an accidental oil spill.

The recommended plan would leave other commercial traffic on the river, mostly sand and gravel barges, which the study recommends be continued since this subregion will probably be exporting these construction materials to areas in the western part of the study region.

Recreation and open space.

The principal emphasis of the plan in the Connecticut River Estuary subregion is to protect fragile and scenic shorelands, waters, and forests. Several state and local acquisitions are, therefore, recommended to prevent loss of irreplaceable resources, protect fish and wildlife populations, and provide increased access for recreational enjoyment of the resources.

Highlights of the recreation and open space recommendations of the study include state acquisition of Eustasia Island in Lyme for use as a wildlife preservation and nature observation area. Attractive sites for limited recreational development might include 500 acres at Messerschmidt Pond in Deep River, and expansion of Chatfield Hollow State Park in Killingworth by acquisition of 160 acres and easements for some recreational rights on 440 acres (all of which is presently owned by the New Haven Water Company). These areas would provide for a variety of casual recreation activities, including hiking, picnicking, camping, fishing, wildlife observation and photography. As many as 350 picnic sites and 150 camp sites might be part of the developed facilities on the acquired lands. Also recommended is expansion of Hammonasset State Park by state acquisition of about 500 additional acres, in Clinton and Madison, on both the east and west banks of the Hammonasset River, including wetland area, between Route 1 and the Connecticut Turnpike. Development here should include 200 picnic sites, 200 campsites, hiking paths and the expansion of the existing nature center into a Classroom by the Sound.

Of the some sixty-three miles of shoreline on both the river and the Sound in this region, about eight miles are in public ownership. Much of this public land is situated along the estuary and is not now swimmable. If abatement programs proceed on schedule, the effect would be to provide several miles of shoreland for limited, water-oriented recreation, including swimming.

This alone cannot satisfy anticipated regional needs for major state park facilities. The study has therefore identified a number of local action opportunities for Class B beaches in areas of the region which are subject to periodic tidal flooding. Class B beaches are eligible for federal aid so long as they provide access, including parking, for non-residents. A modest differential fee between residents and non-residents is permitted, although it would have to bear some relationship to additional operating and maintenance expenses. Among these opportunities are Plum Bank and Great Hammock Beaches in Old Saybrook (0.9 mile), Sound View in Old Lyme (0.5 mile), Cedar Island in Clinton (0.1 mile), and Duck Island Roads in Clinton and Westbrook (1.5 miles). Most of these areas could be acquired either before or, more likely, after flood damages occurred.

It appears neither possible nor desirable to satisfy most of the projected increase in boating demand in the region. Most of this demand originates with the seasonal residents and visitors from outside the region. A few limited opportunities for marina development appear to exist north of Essex along the west bank of the river where present local zoning would permit it. Some modest expansion of existing facilities in the coastal harbors of Clinton and Westbrook might also help to offset some of the future demand. It should be noted that these are just *potentials*, they are not necessarily recommended by the study. Detailed small boat harbor studies for each of the Sound's recreational harbors, coves, and embayments, should be developed, balancing the need to protect some particularly sensitive areas with the growing demands for boat storage and use. See 2.3 Outdoor Recreation. The study recommends development of a public marina facility, including boat rentals, limited slips and moorings, ramps, and a launch service, at Old Saybrook. Otherwise, the deficit will have to be made up by looking to the major urban harbors, like New Haven, as an alternative.

Development of a small recreational ferry or launch service from Old Saybrook and Essex to the Connecticut River Islands and Selden Neck State Park would improve access to these areas as well as enhance the recreational experience.

Other Issues

There are a number of other, less critical issues that the study has examined in the Connecticut River Estuary subregion. Among them:

Coastal erosion damages presently amount to about $350,000 annually in this region, and could increase to $530,000 annually by 1990 and $1,050,000 by 2020. Through the state program of annual maintenance of

existing beach erosion control structures and adoption of suitable land use regulations in erosion prone communities, these damages can be reduced by about one-third. The rest of the damages are beyond practical reduction in environmentally and economically acceptable ways.

Upland erosion and sedimentation damages amount to $580,000 in 1970, with the most significant losses coming from untreated croplands, construction sites, and streambanks. Future damages can be reduced by over one-half by a number of measures, including: 1) careful selection and planning of construction sites as well as mandated retention of vegetative cover in urban areas; 2) a number of structural and non-structural measures for agricultural and forest lands; and 3) enforcement of the state's program to control roadbank erosion on existing and new highways.

Flood damages presently amount to about $1.1 million annually in the region, the lowest figure for any of the Connecticut subregions. However, a recurrence of the 1938 hurricane could cause $5.4 million tidal flood damage and as much as $16.2 million in 2020. Riverine flooding damages in this area from a 100-year frequency storm would amount to $4.6 million. The tidal flooding damages are scattered throughout the region, affecting seasonal residences primarily, with Old Lyme and Old Saybrook suffering the greatest amounts. Flood plain management measures should reduce projected future damages by about 25 percent. Alternative solutions to the tidal flood threat at Point of Woods should be studied. Such alternatives might include floodproofing, flood plain zoning, and relocation of development in the flood plain, as well as some structures. As noted in the discussion above, several floodprone areas might revert to open beaches, with acquisition planned immediately after a natural disaster.

Water supply is more a problem of distribution than of supply in the region. Three of the towns, Chester, Deep River, and Essex, are served by the Chester Division of the same company, and the other three, Old Lyme, Lyme, and Killingworth, have only small privately-owned community water systems. The key water supply recommendation here is to provide for inter-connection between each of these systems where economically possible, to safeguard against future possible shortages or disruptions of service. These interconnections could be developed either by the Connecticut Water Company or a special regional water authority. For new sources, ground water development projects would provide an additional 1.0 million gallons a day (MGD) by 1990, and 6.0 MGD during the 1990-2020 period, at costs of $600,000 and $3.6 million respectively, in the towns of Chester, Clinton, Deep River, Essex, Lyme, and Old Lyme, while surface supplies could be increased by 4.6 MGD through raising both the Killingworth and Wilcox Reservoirs before 1990, at a cost of $10.0 million. Augmentation of storage in Killingworth should be accomplished by diversion of waters from Menunketesuck River and Murray Ponds.

South Central Connecticut Subregion 3

The Setting

The South Central Connecticut subregion includes the city of New Haven and the fourteen surrounding towns. This is part of Connecticut's densely populated urban spine. Typical of the pattern in large urban areas as decentralization takes place, the outlying towns are losing their rural and suburban character. The central area of this region, including New Haven, West Haven, and the towns of Hamden, East Haven and North Haven, is more developed than any other subarea in the Long Island Sound Study region. Remarkably though, nearly half of the land in the subregion as a whole is uncommitted. Much of this open space is situated in the towns of North Branford, Guilford, and Madison. Vast water company holdings occupy the northern sections of these towns.

New Haven Harbor dominates South Central Connecticut's fifty-eight mile coastline, which is largely rocky, although it is interspersed with bays, inlets, and natural beaches. Important natural features of Greater New Haven include East and West Rocks; West Rock Ridge and Sleeping Giant on the west and north; and the Saltonstall Ridge on the east. In addition, three major waterways feed into the New Haven Harbor: the West River, the Mill River, and the Quinnipiac, with its extensive marshes. Major cultural attractions in this region include numerous buildings of historical or modern architectural interest, Yale University, and unspoiled sections of the old New England towns of North Branford, Guilford, and Madison.

The region's population grew from about 449,000 to 508,000 between 1960 and 1970, or about 11 percent. While continued development is anticipated in the relatively densely populated central area of the region, the most significant development pressures over the next few decades will probably occur in sparsely developed suburbs to the east. During the past decade, much of the region's growth took place in the western coastal towns including the towns of West Haven, Milford and Orange. By 1972, this area contained nearly a quarter of the subregion's population.

If present trends continue however, population will increase to about 616,000 by 1990 and 727,000 by 2020 in the region as a whole. These projections represent a sharp decrease in the annual growth rate, from about 1.2 percent average annual compound rate to 0.6 percent.

Significant coastal and water-related activities in Subregion 3 include the receipt and distribution of waterborne cargo – particulary refined petroleum products – boating, swimming, summer vacationing and some seasonal homes, electric power production, commercial oystering, and industrial and municipal waste disposal.

Major Coastal Problems

The major coastal problems in the South Central Connecticut Subregion include rational management of the shoreline; improving local water quality, especially in New Haven Harbor; improving the safety and efficiency of the existing marine transportation system; and meeting the regional and extra-regional demand for expanded recreation facilities.

Shoreline Management

Perhaps more than any other subregion in the study, South Central Connecticut represents the gamut of conflict that can take place on the shoreline in the absence of a plan which does not have local, state, and federal consensus. While debate over some twelve acres of marginally valuable and unmapped mudflats in New Haven Harbor has held up development of a much-needed regional secondary waste water treatment facility, small areas of valuable salt marsh were either dredged or filled along the Quinnipiac River in New Haven, the Branford River, and the Farm River in East Haven, which in the aggregate represent a significant loss indeed. It should be noted that much of this occurred prior to the enactment of state laws protecting wetlands. At the same time, hundreds of units of shorefront housing with little or no provision for general public access were developed or proposed in areas of Milford, West Haven, East Haven, and Branford, in many cases on land which had for some time provided at least informal public access to

the shores of the Sound. On New Haven Harbor, several new massive oil tanks have been added, right at the water's edge and without any regard to visual appearance or public access, during the past two years.

Rather than respond specifically to each of these essentially local or subregional issues, or to develop a detailed plan for this region's shoreline, the study has set forth in Section Four: Carrying Out the Plan, a legal and institutional framework for effective local and regional management of the coastal zone throughout the Long Island Sound region. Its provisions would have each locality, working closely with appropriate regional and state officials, develop a plan for its coastal zone. Under this proposed arrangement there are a number of tools specified for each of the different levels of government to insure the wise management of the entire coastline of the Sound.

There are a number of specific policy, conservation, and development recommendations the study has made which would represent a significant first step toward the development of a plan for the coastal zone of the South Central Connecticut Subregion. These proposals are discussed in detail throughout this chapter and are summarized in the Map Folio preceding this section. They include:

- Designation of Guilford and Madison Centers and parts of New Haven scenic townscapes.
- Designation and preservation of selected areas, particulary the ridges, valleys, and town centers, of the Green Triangle, an area running between Branford, Old Lyme, and Middletown. Means of preservation should include the use of proposed state environmental bond funds, federal Land and Water Conservation Act funds, and appropriate local tax incentives and zoning.
- Major harbor debris cleanup program in New Haven Harbor, to include removal of dilapidated or rotting piers and abandoned, grounded vessels. The program, to be carried out by the U.S. Army Corps of Engineers, should be begun by 1980.
- Storage and treatment of combined sewer overflows in New Haven.
- Prompt phasing out of shore-and stream-side solid waste disposal areas in the towns of Milford, West Haven, East Haven, Branford, and Guilford.
- Recreation proposals in the Lighthouse Point park area, at Stony Creek Quarry and Faulkner's Island, and at Silver Sands and Hammonasset State Parks.
- Development of an offshore oil terminal outside New Haven Harbor and a heated pipeline from New Haven to Middletown.
- Expansion or development of general cargo and ferry terminal facilities in New Haven Harbor.
- Relocation of shorefront oil tank farms in New Haven and West Haven to inland locations.

Improvement of Water Quality

Water quality in the South Central Connecticut Subregion suffers from a number of chronic pollution sources. Chief among them are inadequately treated municipal waste water, industrial processing contaminants, combined sewer and storm water overflows and storm runoff from urban and rural areas. Connecticut's Department of Environmental Protection and municipalities – with the financial and technical assistance of the U.S. Environmental Protection Agency – have made significant strides over the past decade toward abating both municipal waste water and industrial pollution in the suburban towns outside New Haven.

The state's emphasis in this subregion has been to encourage system regionalization and secondary treatment for the former source and pretreatment before municipal facility processing for the latter. These new facilities are being designed to accommodate the anticipated growth in this subregion.

Even after all of these measures are fully operational, though, it appears as if there will be significant water quality problems in the Quinnipiac River, New Haven Harbor, and Branford Harbor. In the Quinnipiac River, loadings from a number of municipal waste water treatment facilities and industrial plants, together with runoff in rural areas, exceed the assimilative capacity of the Quinnipiac River. In New Haven Harbor, the continuing delay of the construction of a secondary waste water treatment plant for the northern and western drainage basins, as well as the nature and extent of the combined sewer system in the city of New Haven, may slow the achievement of mandated goals. In Branford, the existing waste water treatment works need to be expanded to handle the effluent of Branford's burgeoning population and serve a part of North Branford as well. Moreover, it appears that tidal flushing in the area of the treatment plant's outfall is inadequate to fully mix and dilute that facility's effluent, causing nutrient enrichment and algae blooms.

In addition to these specific constraints upon the region's ability to achieve swimmable-fishable waters, there are a number of chronic, non-point sources of pollution throughout the region. These include oil pollution from spills, combined sewer overflows, seepage from oil terminals, leachates from solid waste disposal areas on the shore and adjacent to streams inland, and even marine toilet discharges in poorly flushed coves and harbors.

Connecticut, together with the communities along the Quinnipiac River and New Haven Harbor, should develop an areawide water management ("208") program by 1976. The program would become the vehicle for the integration of land use and water quality management, as well as the implementation of proposed water quality restoration programs.

The study also recommends the following specific actions to achieve fishable-swimmable waters throughout the South Central Connecticut Subregion by 1990:

- On the Quinnipiac River, the towns of Meriden and Wallingford should comply with state orders to expand their present treatment facilities, with state and federal financial aid, by 1978. The towns of North Haven, Southington, and Cheshire should also consider upgrading their present treatment facilities by 1980.
- In New Haven Harbor, the appropriate federal, state and city agencies should reach agreement immediately on the most suitable manner of upgrading the East Street and Boulevard treatment facilities so that secondary treatment will be provided by 1980.; and begin research immediately on alternative means of control and treatment of combined sewer overflows. Possible alternatives include overflow storage and treatment, secondary wastewater treatment plant expansion, and computer-operated, system-wide diversion and storage. Implementation should begin no later than 1980.
- In Branford Harbor, the town should comply with state orders to expand its existing facility by 1980. In addition, both the state and the town should move forward expeditiously with extension of the plant's outfall to an area of better flushing.
- Throughout the entire region, the state should require accepted land management practices to abate the effects of urban runoff on the waters of and tributary to the Sound.
- Contingent upon the development of federal guidelines, the study has identified the potential for permanent marine toilet pumpout facilities, to include landing piers, a pump out device and appropriate pretreatment facilities at waste water treatment plants at New Haven, West Haven, Milford, Branford, and Guilford. The study has also identified the opportunity for mobile pump out trailers at Milford Harbor, New Haven Harbor, Quinnipiac River, Farm River, Branford River, Stony Creek, and Guilford.
- State and local governments should work together to speedily implement the State's *Proposed Connecticut Solid Waste Management Plan* which would have much of the solid waste from this region transferred to major recovery facilities in New Haven, Bridgeport, and Ansonia. Contract negotiations for development of such a facility in the Greater New Haven area are expected to begin early in 1975. Affected would be those towns with solid waste disposal areas, including Milford, West Haven, New Haven, North Haven, East Haven, and Branford.
- State and local implementation of the study's recommendations for port consolidation and coastal zone management. The former is outlined briefly below. Both of these actions and several of the others above are described in greater detail in Section Two: The Plan by Major Subject.

Perhaps as important as the restoration of polluted waters is the preservation of existing high quality waters. To this end, the study recommends the designation of a number of relatively pristine streams and estuarine areas as non-degradation zones, which prohibit both additional point and most non-point sources of pollution, in order to preserve fish, shellfish, and recreational waters. Examples include the Hammonasset Beach and Seaview Beach areas, in Madison, extending westerly to Sachem's Head. In other areas throughout the subregion, the study would urge government officials to protect high water quality areas by severely restricting the development of critical water-related lands such as flood plains, wetlands, and erosion-prone areas.

Marine transportation system improvements

Highlights of the plan in New Haven Harbor, the third largest port in New England, relate to the expansion of port facilities for receiving, storage, and distribution. Bulk cargoes such as scrap metal, iron and steel, and general cargo should continue to be handled in the harbor, but petroleum products are by far the most important here.

By 1985, the plan calls for construction by a proposed state petroleum receiving and distribution authority (PRDA) of an offshore terminal outside New Haven Harbor for receiving gas and distillate oil, with a submarine pipeline to shore. A similar facility has been recommended at Bridgeport Harbor. These clean products would be transshipped using the existing pipeline to Hartford, Springfield, Massachusetts and other areas, and shipped by truck from each storage tank farm to the nearby market area. A second clean product pipeline should be built from New Haven north to the Hartford area by 1990, as demand approaches the capacity of the existing line. This will eliminate gas and distillate barge traffic on the Connecticut River. The offshore berth will help reduce vessel traffic in the inner part of New Haven Harbor, thus encouraging the development of recreational boating and other water-related activities. By receiving large tankers offshore and piping the products to inland storage centers, harbor dredging, total vessel trips, and the likelihood of oil spills should all be reduced. The study proposes eventual relocation of three-fourths of the oil storage tanks from the harbor side to appropriate inland sites, also to be developed by the PRDA, and expansion of existing inland storage sites. This will improve shoreline aesthetics, facilitate improved access to the waterfront, and increase the efficiency of product distribution.

To transport residual oil, the study recommends construction of a heated pipeline from New Haven to Middletown by 1985. Although the demand for residual oil is not expected to increase substantially, it appears that current volumes alone could more economically be handled by hot line than by the present system of distribution – barge shipping from Groton over to and up the Connecticut River to Middletown and Hartford. There are also major environmental benefits to the development of a hot line. Along

with full utilization of the existing clean line to Hartford, this will eliminate all oil barge traffic on the Connecticut River, as well as the need for constant dredging to maintain the fifteen-foot channel. The increased residual oil traffic at New Haven will, in turn, require deepening the New Haven channel from thirty-five to forty feet.

The study has concluded that rather than develop new bridges across the Sound, the New York and Connecticut Departments of Transportation should give serious consideration to the operation of a year-round ferry service between New Haven, Connecticut and the Wading River/ Shoreham area of Long Island. Details of costs and conditions of operation of this and other routes are presently being investigated by the Tri-State Regional Planning Commission. See Section 2.6 Marine Transportation.

Future recreation needs

Large anticipated increases in this subregion's recreation demand are fanned by population growth and affluence, as well as the influx of summer visitors.

Significant portions of South Central Connecticut are still in their open state, including forests, undeveloped uplands, agricultural lands, and wetlands. In addition to the selected recreational acquisitions shown in the Map Folio, the study urges local and state governments to examine additional acquisition and regulation opportunities in areas of key open space potential.

The principle focus of this study, though, is the shoreline: fifty-eight miles of rocky, irregular coast of which only fifteen are in public ownership. Only a small fraction of this, however, is available to the general public for beach swimming. The shorefront beaches in Subregion 3 presently open to the general public include Hammonasset State Park in Madison, Lighthouse Point Park in New Haven, which is usually closed several times a year due to pollution, and the undeveloped Silver Sands State Park in Milford.

To supplement these, the study recommends the following new and expanded shorefront recreation facilities:

- **Stony Creek Quarry/Faulkner's Island.** Both parcels should be acquired by 1980 to serve as a single interrelated casual recreation resource, to be included in the Long Island Sound Heritage. A small recreational ferry or launch would provide a means of access to the historic lighthouse island, which the Coast Guard will soon be automating. Development of both units could provide 300 picnic sites and at least one-half mile of beach.
- **Silver Sands State Park** should be developed immediately by the state and expanded by 1980 as part of the Long Island Sound Heritage. Additional acquisition should include the flood prone area of Fort Trumbull Beach (about 0.3 mile) and Charles Island, which should be significantly enlarged and nourished with sandfill. A boardwalk should be developed from the expanded and developed Silver Sands State Park to Charles Island to serve as both a fishing pier and as the primary means of access to the island. Development plans on the island and and at the shoreside park could include about two miles of beach (including the sand nourished shore of the island), 500 picnic sites, and a small public marina facility including boat rentals and slips.
- **Hammonasset State Park** in Madison should be expanded by state acquisition of about 500 additional acres in Clinton and Madison, on both the east and west banks of the Hammonasset River, including wetland area between Route 1 and the Connecticut Turnpike. Development here should include 200 picnic sites, 200 campsites, hiking paths, and the expansion of the existing nature center into a Classroom by the Sound.
- **Lighthouse Point Park** should be upgraded and expanded to the east by 1985, through the acquisition of flood-prone lands along Shell Beach on an "as-they-become available" basis. The entire complex could be designated as a state park and developed with about one-half mile of beach, 500 picnic sites, and provisions for a ferry service to downtown New Haven. The purchase and restoration of portions of the Morris Creek wetlands and the development of a beach and wetlands boardwalk and foot bridge would provide an excellent field lab for a Classroom by the Sound here.
- **West Haven Beach** should be further developed by the city with state and federal financial assistance, with additional parking and beach facilities by 1980, to provide full utilization of two miles of beach from Sandy Point to the fishing pier. Non-resident user fees should reflect the additional maintenance costs required, while public transportation should serve most of the New Haven urban area.

The study has also identified a number of opportunities for local acquisition of flood prone land for development as Class B beaches. Class B beaches are eligible for federal financial aid so long as access, including parking, is available to non-residents. A modest admission fee is permitted, although it would have to bear some relationship to the additional operating and maintenance expenses. Among these are Circle and East River Beaches in Madison (0.6 mile), Silver Sands and Momauguin Beaches in East Haven (1.0 mile), and Milford Point Beach in Milford (0.7 mile).

In addition to these shorefront parks, the study recommends a number of acquisition and/or development opportunities which would help to deflect some of the recreation demand inland. Among them:

- State acquisition and limited development of an additional 275 acres at **Sleeping Giant State Park** in Wallingford. Development should include 200 picnic sites.
- State acquisition and development of 300 acres at

Turkey Hill in Orange. Development should include about 200 picnic sites.

- Development by the state, working together with the New Haven Water Company, of limited hiking and picnicking facilities on selected water company-owned lands. Through sensitive development, compatible with the objective of protecting public water supply sources, these lands can help satisfy some of the future need for extensive recreational facilities, such as picnic grounds, walking trails, and perhaps some limited opportunities for primitive campground development. Particularly suitable are the watersheds of Lake Watrous in Bethany (50 picnic sites), Lake Gaillard in North Branford (200 picnic sites), and the Maltby Lakes in West Haven (50 picnic sites).

The South Central Connecticut Subregion is one of the very few within the study area's boundaries that appears to be capable of meeting future needs for boat storage. In addition to the public marina already cited at Charles Island in Milford, there would appear to be a potential for several thousand boats in New Haven Harbor utilizing both wet and dry storage. It should be noted that these are just *potentials*, they are not necessarily recommended by the study. Detailed small boat harbor studies for each of the Sound's recreational harbors, coves, and embayments should be developed, balancing the need to protect some particularly sensitive areas with the growing demands for boat storage and use. See Section 2.3 Outdoor Recreation. The recreational potential of New Haven Harbor should increase significantly with alterations in the marine transportation system discussed above.

Also in New Haven, the study recommends development of a public marina facility, to include boat rentals, limited slips and moorings, ramps and a launch service.

In an effort to insure the continued vitality of the fisheries resource of the Sound and the opportunity for the general public to enjoy it, the study has made a number of recommendations regarding both its management and use. See Section 2.4 Sport Fisheries and Wildlife. Of particular significance in this subregion are those recommendations which would involve:

- The development of a Classroom by the Sound, a marine-oriented program of environmental education with strong ties to local schools. These should be established in cooperation with the State Department of Education, by Connecticut's Department of Environmental Protection, where possible through modification of existing facilities. Possible Classroom locations in Subregion 3 include one in conjunction with the Fort Hale Restoration Project, and Hammonasset State Park, where the existing nature center could be expanded.
- Construction of at least one fishing pier, perhaps in the City Point area of New Haven.
- Construction of a fish reef in New Haven Harbor.

Other issues

There are a number of other, less critical issues that the study has examined in the South Central Connecticut Subregion. Among them:

Flood damages presently amount to $3.5 million annually in the region. However, a recurrence of the 1938 hurricane could cause $5.5 million tidal flooding damage and as much as $16.5 million in 2020. Riverine flooding damages in this area from a 100-year frequency storm would amount to $25.4 million. The tidal flooding damages are scattered throughout the seven coastal communities, with some major damages in every one of them. Branford and New Haven suffered the greatest losses. Adoption by every town of federal flood insurance, with its prerequisite flood plain development controls, could eliminate 26 percent of the future projected damages. Measures recommended to reduce riverine flood damages include dams, land treatment, and channelization at Farm River in East Haven, Farm Brook in Hamden, Neck River in Madison, Harbor Brook in Meriden, Munger Brook in North Branford, and West River in Woodbridge. These projects should be completed by 1990, at a total cost of $8 million, 70 percent of which would be borne by the federal government. In addition, the recommended redevelopment of the East Haven beachfront and the Fort Trumbull Beach in Milford and the other potential local shore redevelopments would eliminate several of the major tidal flood damage centers in the region.

Water supply. Present public water needs in the South Central Connecticut Region are supplied by four major water systems: the New Haven Water Company's extensive interconnected system, the Guilford Division of the Connecticut Water Company, and the Meriden and Wallingford Municipal Water Departments, all of which utilize a mix of surface and ground water sources. Anticipated needs of the subregion can be met through the following measures: ground water development in Cheshire, Guilford, Meriden, North Haven, and Wallingford to provide an additional 4 million gallons a day (MGD) by 1990 and 10 MGD by 2020, at costs of $2.4 million and $6.0 million respectively; development of a pumping station at Lake Gaillard by 1990, increasing safe yield by 6.0 MGD at a cost of $0.8 million; construction of a rapid sand filtration plant at Lake Whitney by 1980, increasing safe yield by 15 MGD at a cost of $12.0 million; increasing the holding capacity of the Parmallee Brook Reservoir during the 1990-2020 period (1.5 MGD) at a cost of $0.6 million; diversion of flood flows from the Coginchaug, Muddy, and North Madison Rivers during the 1990-2020 period (12.8 MGD) at a cost of $4.5 million; and interconnection with the Bridgeport Hydraulic Company system so that water from that system could be delivered to Subregion 3 if needed. Also, the four water companies in the region should provide transmission main interconnections so that shortages in one system can be compensated by surpluses in another system.

Future needs for adequate electric power. The study has not made site-specific recommendations for future power plant development, since each new facility is subject to detailed review and evaluation requirements well beyond the scope of this study. It has instead outlined a series of policy recommendations to insure the safe provision of this form of energy for the future. In addition, some potential sites for future generating facilities have been identified. These are subject to much more detailed review, as required by state and federal licensing procedures. In South Central Connecticut, the most obvious potential appeared to be some expansion at the Coke Works site. If the study's recommended conservation techniques are fully utilized, additional development may be postponed until more environmentally suitable or publicly acceptable forms of generation are available.

Coastal erosion damages presently amount to $400,000 annually, and could increase to $600,000 annually by 1990 and $1,200,000 by 2020. Through the state program of annual maintenance of existing beach erosion control structures and adoption of suitable land use regulations in erosion prone communities, these damages can be reduced by about 36 percent. The rest of the damages are beyond practical reduction in environmentally and economically acceptable ways.

Upland erosion and sedimentation damages amounted to $2,060,000 in 1970, with the most significant losses coming from untreated croplands, construction sites, and streambanks. Future damages can be reduced by an estimated 58 percent by the following means: 1) urban non-structural measures involving construction site selection and planning and retention of vegetative cover; 2) structural and non-structural measures for agricultural and forest lands; and 3) state program to control roadbank erosion on existing and new highways.

Greater Bridgeport and the Lower Housatonic Valley Subregion 4

The Setting

This 130,000-acre subregion is predominantly urban, with some rural stretches in the northern towns, including extensive watershed lands. Bridgeport Harbor and adjacent embayments dominate the thirty-mile coastline, which also includes 200 acres of open land and wetlands in Stratford, known as Great Meadows. This is the largest salt marsh in the region, and an important scenic resource. Protecting Great Meadows from the Sound are Lewis Gut, Pleasure Beach, and Long Beach, a long barrier beach. A large shoal lies off Stratford, and the Housatonic River Estuary in this town separates the subregion from South Central Connecticut. The remaining shoreline is composed of rock and sandy beaches. Among the many cultural and historic attractions in this area are the American Shakespeare Festival Theatre in Stratford, the 19th century Fairfield County Courthouse in Bridgeport, and Trumbull Indian Ledge Park.

The Greater Bridgeport area is densely populated along the shoreline and in parts of the Valley, with relatively light settlement in the northern section. According to the most recent census figures, the subregional population rose from 338,000 to 385,000 between 1960 and 1970. This reflects a 12 percent increase in Greater Bridgeport, where growth occurred primarily in the towns of Fairfield, Trumbull, Monroe, and Easton; and a 22 percent increase in the Valley, where Shelton experienced the greatest residential growth. Of all the urban areas in Connecticut, Bridgeport has the largest population. Growth in the high density towns of Bridgeport and Stratford has been slow since 1960, as development pressures have been shifting to nearby suburban areas. In the Valley, intense development occurs in a small section along the Naugatuck and Housatonic Rivers, spurred by industrial expansion in the so-called Route 8 Corridor. The subregional population is expected to reach 473,000 by 1990 and 544,000 by 2020. In accordance with anticipated regional, state, and national population trends, these projections represent a significant decrease in the average annual compound rate of growth, from about 2 percent for 1960-70 to 0.7 percent between 1990 and 2020.

The principal coastal and water-related activities in this subregion include commercial shipping of petroleum products and general cargo, recreation, electric power production, industrial and municipal waste disposal, and a ferry terminus for the Port Jefferson ferry.

Major Coastal Problems

The major coastal problems in Subregion 4 include improving local water quality, especially in Bridgeport Harbor and the Housatonic Estuary; increasing the efficiency and safety of the marine transportation system; protecting the available shoreline from overdevelopment; meeting future demands for recreation facilities, particularly marina space; and meeting anticipated regional needs for electric power in environmentally acceptable ways.

Improvement of Water Quality

Water quality in the subregion, particularly Bridgeport Harbor and the Housatonic Estuary, suffers from a number of chronic pollution sources, including inadequately treated municipal waste water, industrial processing contaminants, and combined sewer and storm water overflows. Connecticut's Department of Environmental Protection and municipalities, with the financial and technical assistance of the U.S. Environmental Protection Agency, have made significant strides over the past decade toward abating both municipal waste water and industrial pollution. The state's emphasis in this subregion has been to encourage system regionalization and secondary treatment for the former source and pretreatment before municipal facility processing for the latter. These new facilities are being designed to accommodate present and anticipated growth in this subregion.

Even after these measures are fully operational, however, it appears that there will remain a significant water quality problem in both Bridgeport Harbor and the lower Housa-

tonic River. This is due to the nature and extent of both point and non-point pollution sources including solids, nutrients, and bacteria from combined sewer and storm-water overflows, particularly from Bridgeport, Shelton and Derby; seepage from oil terminals; and leachates from shore and streamside solid waste disposal areas.

Connecticut, together with the communities in the Greater Bridgeport area, should develop an areawide water management ("208") program by 1976. The program would become the vehicle for the integration of land use and water quality management as well as the implementation of proposed water quality restoration programs.

The study also recommends the following specific actions to achieve fishable-swimmable waters in these areas by 1990:

- Application of accepted land management practices along the drainage shed of the Poquonock, and, to some extent, the Housatonic River basin, to abate urban runoff.
- Contingent upon the development of federal guidelines, the study has identified the potential for permanent toilet pump out facilities, to include landing piers, a pumpout device, and appropriate pretreatment facilities at waste water treatment plants in Fairfield, Bridgeport, and Stratford. The study has also identified the opportunity for mobile pump out trailers on the Housatonic River, Bridgeport Harbor, Black Rock Harbor, Southport Harbor, and Ash Creek.
- All of the towns in the subregion, except Shelton and Trumbull, have solid waste disposal areas adversely affecting water quality. The study urges the State to speedily implement its Proposed Connecticut Solid Waste Management Plan which would have much of the solid waste from this region transferred to a major recovery facility in Bridgeport. Solid wastes from Shelton would be transferred to Ansonia. All solid waste disposal areas could thereby be rendered safe to water quality by 1990.
- State and local implementation of the study's recommendations for port consolidation and coastal zone management – the former is outlined briefly below. All of these actions are discussed in greater depth in Section Two: The Plan by Major Subject.

Perhaps as important as the restoration of polluted waters is the preservation of existing high quality waters. To this end, the study recommends the designation of a number of relatively pristine streams and estaurine areas as non-degradation zones, which prohibit both additional point and most non-point sources of pollution, in order to preserve fish, shellfish, and recreational waters. Examples include the outer portion of Southport Harbor and the Sasco Brook area in Fairfield. In other areas throughout the subregion, the study urges government officials to protect high water quality areas by severely restricting the development of critical water-related lands such as flood plains, wetlands, and erosion-prone areas.

Marine transportation system improvements

Planned redevelopment of Bridgeport Harbor will improve the efficiency of commercial use and greatly enhance its recreational potential, by upgrading water quality and increasing public access to the shore. Bridgeport is a busy commercial port, handling millions of tons of freight annually. There is also significant recreational boating activity in the various tributaries and coves adjacent to the harbor. Shipping of commodities such as chemicals, lumber, and scrap metal serves local industry, but petroleum products are by far the most important handled here.

By 1990, the study's proposed plan calls for construction by a proposed state petroleum receiving and distribution authority (PRDA) of an offshore terminal outside Bridgeport Harbor for receiving gas and distillate oil, with a submarine pipeline to shore. A similar facility has been recommended at New Haven Harbor. These so-called clean products would be piped from the offshore berth to harbor storage facilities and subsequently shipped by truck throughout the market area served by Bridgeport. In addition, a Bridgeport-Bronx pipeline for gas and distillate, possibly constructed along the railroad right-of-way, is recommended for completion by 1995. The offshore berth would help reduce vessel traffic in the inner part of Bridgeport Harbor, thus encouraging the development of recreational boating and other water-related activities. By receiving large tankers offshore and piping the products to inland storage centers, harbor dredging, total vessel trips, and the likelihood of oil spills should all be reduced.

Bridgeport also receives large amount of residual fuel, mostly for the power plants in the harbor area. The study recommends construction of a heated pipeline to transport residual oil from Bridgeport to Devon by 1985. Although the demand for residual oil is not expected to increase substantially, it appears that current volumes alone could more economically be handled by hot line than by the present system of barging the fuel from New Haven to the power plant at Devon.

Shoreline protection

Rather than develop a detailed shoreline plan for each of its nine subregions, the study has set forth in Section Four: Carrying Out the Plan, a legal and institutional framework for effective local and regional management of the coastal zone throughout the Long Island Sound region. Its provisions would have each locality, working closely with appropriate regional and state officials, develop a plan for its coastal zone. Under this proposed arrangement, there are a number of tools specified for each of the different levels of government to insure the wise management of the entire coastline of the Sound.

There are a number of specific policy, conservation, and development recommendations the study has made which would represent a significant first step toward the develop-

ment of a plan for the coastal zone of the Greater Bridgeport-Valley Subregion. These proposals are discussed in detail throughout this chapter and are summarized in the Map Folio preceding this section. They include:

- Designation and protection of Southport Harbor as a scenic townscape.
- Establishment of an Historic District at New Pasture Point on the east side of Bridgeport Harbor, with eventual redevelopment for new housing, restaurants and water-related activities and conversion of the old United Illuminating power plant to a boutique shopping plaza.
- Major harbor debris cleanup program in Bridgeport Harbor, to include removal of dilapidated or rotting piers and abandoned, grounded vessels. The program, to be carried out by the U.S. Army Corps of Engineers, should be begun by 1980.
- Prompt phasing out of shore and streamside solid waste disposal areas in Fairfield, Bridgeport, Stratford, Easton, Monroe, Seymour, Ansonia, and Derby.
- Development of the Pleasure Beach, Long Beach, and Great Meadows complex for intensive and extensive recreation.
- Designation of and long-term relocation from selected flood-prone areas along the coastline.

Future recreation needs

Greater Bridgeport is enormously rich in terms of shorefront and park land open to the public. However, the need for well-planned, accessible recreation, especially boating facilities, exceeds present supply. In addition to the selected recreation acquisitions shown in the Map Folio, the study urges local and state governments to examine additional acquisition and regulation opportunities in areas of key open space potential.

Some of the projected increase in boating demand could be met through private development of up to 1000 wet and 1600 dry slips in Bridgeport's inner harbor and the Housatonic River. These figures reflect *potential* for private development only. They do not constitute a recommendation of the study. Detailed small boat harbor studies for each of the Sound's recreational harbors, coves, and embayments should be developed, balancing the need to protect some particularly sensitive areas with the growing demands for boat storage and use. See Section 2.3 Outdoor Recreation.

The study does recommend, however, the development of a public marina facility, including boat rentals, limited slips and moorings, ramps, and a launch service in Bridgeport Harbor.

The only opportunity for regional beach development identified by the study in this subregion is Pleasure Beach in Bridgeport. This is a barrier beach presently owned by Bridgeport but underutilized. As part of the Long Island Sound Heritage, it should be transferred to the state by 1978 and substantially upgraded for development as a state park. Beach stabilization might be provided by selective planting, as recommended by the Bridgeport Conservation Commission. In addition, the beach to the southeast, known as Long Beach and owned by the town of Stratford, should be included in this new park as the leases on the land expire. Additional acquisition in this area could include the Great Meadow Wetlands complex for use in conjunction with a Classroom by the Sound nature center. A small recreational ferry or launch service should be developed between downtown Bridgeport and the existing ferry dock at Pleasure Beach. Additional access would be provided by the retention and restoration of the existing bridge to Pleasure Beach from Bridgeport, and by development of a new access road to Long Beach from Great Meadows Road in Stratford. Some parking should be provided near the northern terminus of the bridge, with shuttle bus and pedestrian access from there. Recreational use of portions of Long Beach will have to be restricted during the Least Tern nesting season.

The natural characteristics of this area set it apart from most other shorefront areas in this densely developed subregion, and underscore its considerable recreational potential. In view of urban deterioration nearby, this entire area is understandably also in demand as a site for commercial development, including construction of a major civic center, which would produce tax revenue for Bridgeport. However, a barrier beach's natural instability and susceptibility to flood damage make it generally unsuitable for such intensive development. Water-oriented commercial activities might be permissible, but these probably would be better located at the developed regional beach at Seaside Park, leaving Pleasure Beach more natural in contrast.

In addition to this shorefront park, the study has identified a number of acquisition and development opportunities which would help to deflect some of the demand inland. Among them:

- State acquisition of **Success Lake** (320 acres) in Bridgeport, if, and as it becomes available, with development to include a swimming area if feasible, 250 picnic sites, and small boat rentals. It should be noted that this area is valuable to the city in terms of its tax base, and perhaps recreational and commercial uses could be combined.
- State acquisition at **Buttermilk Hollow** (twenty acres) in Shelton, with development to include thirty picnic sites and two boat ramps.
- Development by the state, working together with the Bridgeport Hydraulic Company, of limited hiking and picnicking facilities on selected water company-owned lands. Through sensitive development, compatible with the objective of protecting public water supply sources, these lands can help satisfy some of the future need for extensive recreational facilities, such as picnic grounds and walking trails. Particularly suitable are the watersheds of Hemlock and Easton Reservoirs in Easton (200 picnic sites).

The study has also identified one opportunity for local acquisition of contiguous flood-prone land for development as a Class B beach, which would be eligible for federal and state financial aid so long as access, including parking, were available to non-residents. A modest admission fee is permitted although it would have to bear some relationship to additional operating and maintenance expenses. The prime potential for Subregion 4 appears to be two miles at Pine Creek Point in Fairfield.

In an effort to insure the continued vitality of the fisheries resource of the Sound and the opportunity for the general public to enjoy it, the study has made a number of recommendations regarding both its management and use. See Section 2.4 Sport Fisheries and Wildlife. Of particular significance in this subregion are those recommendations which would involve:

- The development of a Classroom by the Sound marine-oriented program of environmental education with strong ties to local schools. These should be established in cooperation with the State Department of Education, by Connecticut's Department of Environmental Protection, where possible through modification of existing facilities.
- Construction of two additional fishing piers at Bridgeport, as currently planned, and investigation of other sites.
- Construction of at least one fish reef in Bridgeport Harbor.

Future needs for adequate electric power

The study has not made site-specific recommendations for future power plant development, since each new facility is subject to detailed review and evaluation requirements well beyond the scope of this study. It has instead outlined a series of policy recommendations to insure the safe provision of this form of energy for the future. In addition, some potential sites for future generating facilities have been identified, subject to much more detailed review, as required by the state and federal licensing procedure. In the Greater Bridgeport-Valley region, the most obvious potential appeared to be some expansion at Bridgeport Harbor or a new facility to replace the 156-megawatt Steel Point Power Plant, which is about to be retired. If the study's recommended conservation techniques are fully utilized, additional development may be postponed until more environmentally suitable or publicly acceptable forms of generation are available.

Other issues

There are a number of other, less critical issues that the study has examined in the Greater Bridgeport-Valley Region. Among them:

Water supply needs in the Greater Bridgeport-Valley Regions are met by surface and ground water sources. The Bridgeport Hydraulic Company serves most of the towns of Greater Bridgeport, while the Valley towns are served mainly by the Ansonia-Derby Water Company and the Seymour Water Company. The study recommends that future needs can best be met by interconnection of the water supply systems, and by developing ground water sources before creating new impoundments. Ground water development in Fairfield would provide an additional 2.7 million gallons a day (MGD) by 1990 at a cost of $1.6 million, with additional ground water development discussed in Subregion 5 providing additional supply to the Bridgeport Hydraulic Company. Development of the Hopp Brook Reservoir in Bethany should provide the northeastern portions of Subregion 4 with about 1.6 MGD by 1990 at a cost of $400,000, while development of the Poquonock River Reservoir in Trumbull by the Bridgeport Hydraulic Company should provide 9 MGD by 1990 at a cost of nearly $11 million. A long-term project proposed by the state of Connecticut calls for diversion of water from the Shepaug River in Southbury to water systems in Southwestern Connecticut. It is expected that this project would deliver about 50 MGD to Subregions 3, 4, and 5. In addition, some water from the West Aspetuck River project proposed for New Milford would be delivered to the area.

One other project would involve use of the Housatonic River, Candlewood Lake and Lake Lillinonah complex as a major water supply source for southwestern Connecticut. While various proposals have been made involving the Housatonic River, one considered in this study would yield 160 MGD at a cost of $80 million. Development of this source would be contrary to present state law, which prohibits the taking of drinking water from any water body receiving wastes, treated or untreated. It might also conflict with intensive recreation use of these lakes and the river. The potential magnitude of the project, however, necessitates an exhaustive study before dismissing the possibility. Use of this source would require a change in state law and policy, improvement of water quality, and resolution of legal problems in use of the reservoir and water rights for providing public water supply. It is still recommended that Connecticut, together with the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency, working through the Corps' Urban Waters Study for the Housatonic, continue investigation of the feasibility of using the Housatonic complex as a major water supply source for this region.* In any event, state-identified upland surface and ground water sources in the watershed should be carefully protected.

Flood damages presently amount to $4 million annually in this region. However, a recurrence of the 1938 hurricane could cause $6 million flooding damage right now and as much as $18 million in 2020. Riverine flooding damages in this area from a 100-year frequency storm would amount

*It should be noted that the study's Coordinating Group concurred in this recommendation, although the State of Connecticut specifically withheld its endorsement.

to $5.7 million. In the past, hurricanes have seriously damaged shore cottages, and flooding has occurred quite far inland. Stratford and several sections of Bridgeport have suffered the greatest losses from tidal flooding. Flood plain management measures should reduce projected future damages by about 25 percent. Such measures might include floodproofing, flood plain zoning, or relocation of development in the flood plain.

Coastal erosion damages presently amount to $460,000 annually, and could increase to $690,000 annually by 1990, and $1,380,000 by 2020. Beach erosion is a serious problem in Fairfield, Bridgeport, and Stratford. Through the state program of annual maintenance of existing beach erosion control structures, and adoption of suitable land use regulations in erosion prone communities, these damages can be reduced by about 36 percent. The study has concluded that the rest of the damages are beyond practical reduction in environmentally and economically acceptable ways.

Upland erosion and sedimentation damages amounted to $1,018,000 in 1970, with the most significant losses coming from untreated croplands, construction sites, and streambanks. Future damages can be reduced by an estimated 58 percent through urban non-structural measures involving construction sites selection and planning and retention of vegetative cover, structural and non-structural measures for agricultural and forest lands, and a state program to control roadbank erosion on existing and new highways.

Southwestern Connecticut Subregion 5

The Setting

Southwestern Connecticut includes eight towns, comprising an inland region and a coastal sector. The inland area includes parts of Greenwich, Stamford, Darien, Norwalk, and Westport, and all of New Canaan, Wilton, and Weston. The coastal sector includes parts of Greenwich, Stamford, Darien, Norwalk and Westport. Bounded by New York State on the west, this region is one of the most highly urbanized areas in Connecticut. With more than half of its land built up, Subregion 5 surpasses all others in the state in percentage of land in residential and industrial use. Inland, agricultural areas are disappearing as most towns experience continual development pressures. The seventy-five-mile coastline, which includes commercial harbors at Stamford and Norwalk, is very irregular, with numerous coves and promontories and several islands. Seven large rivers drain the area. Important scenic and cultural attractions in this region include the Victorian Lockwood-Matthews Mansion in Norwalk, the Nature Center for Environmental Activities in Westport, and the Norwalk Islands, with valuable open space and wildlife refuge.

The Southwestern Connecticut population jumped from 279,000 in 1960 to 334,000 in 1970, an increase of almost 20 percent, as commercial development associated with residential growth occurred in this subregion, despite local resistance to change. In Darien, some sections of the Post Road have remained exclusively residential, but unplanned commercial and industrial strip developments have sprung up along this road in all the other towns of the subregion. Development of rural land and widespread urbanization seem inevitable, and the population is expected to reach 407,000 by 1990 and 505,000 by 2020. In accordance with anticipated regional, state, and national population trends, these projections represent a significant decrease in the annual growth rate, from about 2 percent average annual compound rate for 1960-70 to about 0.7 percent between 1990 and 2020.

The principal coastal and water-related activities in Subregion 5 include recreation; summer vacationing; some commercial shipping, particularly petroleum products; electric power production; and industrial and municipal waste disposal.

Major Coastal Problems

The major coastal problems in Subregion 5 include protection of the shoreline from the deterioration caused by overdevelopment; improving local water quality, particularly in Norwalk Harbor; increasing the safety and efficiency of the present system of transporting petroleum products; meeting future needs for recreation facilities; and meeting anticipated regional needs for electric power in environmentally acceptable ways.

Shoreline Protection

Rather than develop a detailed shoreline plan for each of its nine subregions, the study has set forth in Section Four: Carrying Out the Plan, a legal and institutional framework for effective local and regional management of the coastal zone throughout the Long Island Sound region. Its provisions would have each locality, working closely with appropriate regional and state officials, develop a plan for its coastal zone. Under this proposed arrangement, there are a number of tools specified for each of the different levels of government to insure the wise management of the entire coastline of the Sound.

There are a number of specific policy, conservation, and development recommendations the study has made which would represent a significant first step toward the development of a plan for the coastal zone of the Southwestern Connecticut region. These proposals are discussed in detail throughout this chapter and are summarized in the Map Folio preceding this section. They include:

- A major harbor debris cleanup program in Norwalk and Stamford Harbors, to include removal of dilapidated or rotting piers and abandoned, grounded vessels. The program, to be carried out by the U.S. Army Corps of Engineers, should be begun by 1980.
- Prompt phasing out of shoreside solid waste disposal

areas and inland solid waste disposal areas adjacent to streams, in Wilton, Darien, New Canaan, Weston, and Greenwich.

- Acquisition and/or development of the following sites for recreation or preservation: Sherwood Island State Park in Westport (to be extended); Chimon and Sheffield Islands in Norwalk.
- Designation of the Norwalk Islands archipelago as a special scenic district.

Improvement of Water Quality

Water quality problems in Southwestern Connecticut can be traced to a number of pollution sources, chiefly municipal and industrial waste water discharge and combined sewer and storm water overflows. Connecticut's Department of Environmental Protection and municipalities, with the financial and technical assistance of the U.S. Environmental Protection Agency, have made significant strides over the past decade toward abating both municipal waste water and industrial pollution. The state's emphasis in this subregion has been to encourage regionalization of municipal treatment systems, with the phasing out of smaller, obsolete plants, and pretreatment for industrial pollution before secondary treatment at a municipal plant. All municipal plants will have secondary treatment, including major treatment facilities in Stamford, Norwalk, and Westport, to handle the needs of the adjoining towns of Weston, Darien, Wilton, and possibly New Canaan. It is anticipated that these new facilities will accommodate the anticipated growth in this subregion.

Even after these measures are fully operational, however, it appears that there still will be a significant water quality problem in Norwalk Harbor. This is due to both point and non-point pollution sources, including solids, nutrients, and bacteria from combined sewer and stormwater overflows, particularly from Norwalk; seepage from oil terminals; and leachates from solid waste disposal areas, on the shore and adjacent to streams inland. A supplemental treatment plant currently being designed for Norwalk, to be constructed by 1976 at a cost of $30 million, will minimize pollution from combined sewer overflows.

The study recommends the following actions to achieve fishable, swimmable waters by 1990:

- Application of accepted land management practices along the drainage shed of the Norwalk River basin to abate urban runoff.
- Contingent upon the development of federal guidelines, the study has identified the potential for permanent marine toilet pump out facilities, to include landing piers, a pump-out device, and appropriate pretreatment facilities at waste water treatment plants in Greenwich, Stamford, Norwalk, and Westport. The study has also identified the opportunity for mobile pump out trailers in or near Greenwich Harbor, Cos Cob Harbor, East and West Branches of Stamford Harbor, Five Mile River, Norwalk Harbor, Charles Creek, and Saugatuck River.
- Several of the towns in the subregion have unsatisfactory solid waste disposal areas which adversely affect water quality. These are located in the towns of Wilton, Darien, New Canaan, Weston, and Greenwich. The study urges the state to speedily implement its *Proposed Connecticut Solid Waste Management Plan*, which would transfer much of the solid waste from this region to a major recovery facility in Southwestern Connecticut by 1990.
- State and local implementation of the study's recommendations for port consolidation and coastal zone management. The former is outlined briefly below. All of these actions are discussed in greater depth in Section Two: The Plan by Major Subjects.

Perhaps as important as the restoration of polluted waters is the preservation of existing high quality waters. To this end, the study recommends the designation of a number of relatively pristine streams and estuarine areas as non-degradation zones, where both additional point and most non-point sources of pollution would be prohibited, in order to preserve fish, shellfish, and recreational waters. Examples include the area off the Norwalk Islands, the Saugatuck River south to Westport, and Scott Cove in Darien. In other areas throughout the subregion, the study urges government officials to protect high water quality areas by severely restricting the development of critical water-related lands such as flood plains, wetlands, and erosion-prone areas.

Marine Transportation System Improvements

At Stamford and Norwalk Harbors, commercial traffic will be reduced and recreational activities increased by the study's port consolidation plan. While these two ports would continue to receive residual oil and all general bulk cargoes, they should receive distillate and gas from the Bridgeport-Bronx pipeline by 1995. These clean products would be stored in tank farms situated along the way, and transshipped to the market areas by truck.

In addition, all existing tank farms, except those for residual oil, should be relocated to sites adjacent to the Bridgeport-Bronx pipeline right-of-way. By substantially reducing barge traffic in Stamford and Norwalk Harbors and improving the shoreline's appearance, these modifications for receiving, handling, and distributing gas and distillate oil will encourage the development of recreational boating and other water-related activities.

Continued barging of residual oil is recommended as the most economically feasible means of supplying Stamford and Norwalk's local needs. These are the only ports west of Bridgeport which handle residual oil, most of which is used by the two power plants near the harbor entrances. Future volumes of residual oil received at Stamford and Norwalk

Harbors are not expected to increase substantially.

Future Recreation Needs

As in neighboring subregions, demand for recreation facilities in Southwestern Connecticut exceeds available supply. In addition to the selected recreation acquisitions shown in the Map Folio, the study urges local and state governments to examine additional acquisition and regulation opportunities in areas of key open space potential.

Anticipated boating needs are higher here than in any other subregion of the study area. However, it appears neither possible nor desirable to satisfy the bulk of these needs within this subregion. Some modest expansion of existing slips or moorings may be feasible at Indian Harbor in Greenwich and in the Saugatuck River in Westport. In addition, a couple of boat ramps could be developed at the power plant site on Manressa Island in Norwalk. It should be noted that these are just *potentials*, they are not necessarily recommended by the study. Detailed small boat harbor studies for each of the Sound's recreational harbors, coves, and embayments should be developed, balancing the need to protect some particularly sensitive areas with the growing demands for boat storage and use. See Section 2.3 Outdoor Recreation.

In Norwalk and Stamford, the study recommends development of public marina facilities. Each facility should include boat rentals, limited slips and moorings, ramps, and a launch service.

Demands for additional public beaches must be met primarily by local acquisitions. As part of the Long Island Sound Heritage, the one existing regional beach at **Sherwood Island State Park** in Westport, should be expanded by 1980, to include the flood-prone properties immediately to the west (0.4 mile) and additional land between the northern park boundaries and the Connecticut Turnpike. Additional development would include 500 picnic sites and four boat ramps. In addition, the study recommends that the U.S. Army Corps of Engineers speedily move forward with plans to nourish the existing beach with clean sand fill to its original width, or breadth, of 300 feet.

Sheffield Island in the Norwalk Islands group should be acquired by 1975 for development as a public offshore swimming and general recreation facility. Chimon Island is also recommended for inclusion in the Heritage as a wildlife management and nature observation area. Access to Sheffield Island could be provided by a small public recreational ferry or launch service from Norwalk.

In addition to these shorefront beaches, the study has identified a number of recreation opportunities which would help to deflect some of the demand inland. The study recommends development by the state, working together with the Bridgeport Hydraulic Company, of limited hiking and picnicking facilities on selected water company-owned lands. Through sensitive development, compatible with the objective of protecting public water supply sources, these lands can help satisfy some of the future need for extensive recreational facilities, such as picnic grounds and walking trails. Particularly suitable are the Saugatuck Reservoir watershed and adjacent portions of watershed in the Housatonic Valley Region (300 picnic sites).

In an effort to insure the continued vitality of the fisheries resource of the Sound and the opportunity for the general public to enjoy it, the study has made a number of recommendations regarding both its management and use. See Section 2.4 Sport Fisheries and Wildlife. Of particular significance in this subregion are those recommendations which would involve:

- The development of a Classroom by the Sound marine-oriented program of environmental education with strong ties to local schools. These should be established in cooperation with the State Department of Education, by Connecticut's Department of Environmental Protection, where possible through modification of existing facilities. Possible Classroom locations in Subregion 5 include Shea Island, owned by the city of Norwalk. Instruction could begin on the ferry. See Section 2.3 Outdoor Recreation.
- Construction of a fishing pier at Calf Pasture Beach in Norwalk. The state should build fishing piers on Sheffield Island after acquisition.
- Construction of fish reefs at Noroton Neck and Roton Point.

Future needs for adequate electric power

The study has not made site-specific recommendations for future power plant development, since each new facility is subject to detailed review and evaluation requirements well beyond the scope of this study. It has instead outlined a series of policy recommendations to insure the safe provision of this form of energy for the future. In addition, some potential sites for future generating facilities have been identified, subject to much more detailed review, as required by state and federal licensing procedure. In Southwestern Connecticut, the most obvious potential appeared to be at Stamford, where the retired fifty-three-megawatt power plant could be replaced by a larger facility. If the study's recommended conservation techniques are fully utilized, however, additional development may be postponed until more environmentally suitable or publicly acceptable forms of generation are available.

Other issues

There are a number of other, less critical issues that the study has examined in the Southwestern Connecticut Region. Among them:

Water supply needs in this region are presently met by seven major water utilities providing both ground and

surface supplies. Additional sources will be required in the near future for a number of towns in the region. New Canaan needs a supplemental supply from a neighboring system immediately. Bridgeport Hydraulic or Norwalk would be the major suppliers. The subregion is unable to supply all of its future demands with its own sources and therefore must look to neighboring subregions for additional supply. See Section 3.4 Greater Bridgeport and Lower Housatonic Valley (Subregion 4) for a discussion of problems related to development of the Housatonic River complex.

Ground water development in Stamford, Darien, and Westport would provide 10.6 million gallons a day (MGD) by 1990, at a cost of $6.4 million. Surface supplies could be increased by the Norwalk River Diversion (3.2 MGD) in Wilton, by 1990, at a cost of $3.2 million, and through expansion of the Siscowit Reservoir in New Canaan, the Comstock Brook Reservoir in Wilton, and the Mianus Reservoir in Stamford (5.7 MGD), by 1990, at a cost of $4.5 million. The study recommends that future needs can best be met by interconnection of the water supply systems with the Bridgeport Hydraulic Company system, which could serve as the focal point for future development of water supply sources.

Flood damages presently amount to $4.2 million annually in the region, the highest figure for any subregion in the study area. A recurrence of the 1938 hurricane could cause $13 million of tidal flooding damage and as much as $39 million in 2020. Riverine flooding damages in this area from a 100-year frequency storm would amount to $26.5 million. The tidal flooding damages are scattered throughout the region, with Westport and Stamford suffering the greatest amounts. Other areas of major damage are Norwalk and Greenwich. Flood plain management measures should reduce projected future damages by about 25 percent. The Norwalk River flood control project, including a dam, land treatment, and channelization, is the only structural solution recommended. Also recommended is the study of alternative solutions to tidal flood threats at Compo Beach in Westport. Such alternative solutions might include flood proofing, flood plain zoning, and relocation of development in the flood plain as well as some structures.

Coastal erosion damages presently amount to $460,000 annually, and could increase to $690,000 annually by 1990 and $1,380,000 by 2020. Through the state program of annual maintenance of existing beach erosion control structures and adoption of suitable land use regulations in erosion prone communities, these damages can be reduced by about 36 percent. The study has concluded that the rest of the damages are beyond practical reduction in environmentally and economically acceptable ways.

Upland erosion and sedimentation damages amounted to $1,223,000 in 1970, with the most significant losses coming from untreated croplands, construction sites, and streambanks. Future damages can be reduced by an estimated 58 percent through: 1) urban non-structural measures involving construction site selection and planning and retention of vegetative cover; 2) structural and non-structural measures for agricultural and forest lands; and 3) state program to control roadbank erosion on existing and new highways.

Freight Shipments. In addition to the recommended marine transportation system improvements, the study has made three recommendations with regard to the movement of rail freight shipments which would have an effect on Southwestern Connecticut:

- Implement the recommendation of the Tri-State Regional Planning Commission for the repair of the Poughkeepsie Bridge crossing of the Hudson River and the renewal of rail freight service over the bridge.
- Reevaluate the potential for a New York Harbor tunnel rail freight crossing between New Jersey and Brooklyn.
- Improve the rail freight service over the Hell Gate rail crossing between the Bronx and Queens.

Westchester, the Bronx and Queens Subregions 6A & B

The Setting

The southeastern portion of Westchester County makes up Subregion 6A while approximately 14,000 acres of eastern Bronx and northeastern Queens comprise subregion 6B. There are approximately thirty-five miles of shoreline in subregion 6A and twenty-five miles of shoreline in subregion 6B. Subregion 6C is located in Nassau County and is covered in Section 3.7 of this report.

These two subregions are generally characterized by dense urban development, with pockets of high-rise residential development along the shoreline. In addition, a large number of private and commercial marinas, some parks and wetland areas, and some commercial and light industrial development are located along the shore.

The population of subregion 6A was 380,000 in 1970 and projections indicate an increase of about 10,000 people by 1980. However, after 1980, projections show a probable population decline to 383,000 in 1990 and 370,000 by 2020. Undeveloped lands susceptible to further growth are almost non-existent in this subregion, and their absence is an additional indicator of the stabilization of population demonstrated by the projections.

The population density figures for Subregion 6B are higher than those for any other subregion of the study area. Population projections are available for the entire Bronx and Queens Counties, but separate projections for the specific subregion area 6B were not calculated. However, the projections parallel somewhat the population trends projected for subregion 6A, showing some increase and then a decline between 1980 and 2000. Queens projections, however, indicate a larger percent population increase before stabilization occurs, due to the fact that northern Queens has more remaining space available for potential growth than other portions of subregion 6B.

The principal coastal activities in Subregion 6A and B include water-related recreation and commercial shipping, particularly petroleum products and sand and gravel destined for Port Chester and East Chester Creek. Recreational activity in the southeastern Bronx and in Queens is limited to boating and fishing because poor water quality limits swimming to areas north of City Island most notably Orchard Beach. Accessibility to the shoreline in Queens is extremely limited due to preemption by the Cross Island Parkway and the Fort Totten military reservation. Udalls Cove and Alley Pond Park are two of the more significant open space areas along the north shore of Queens.

Major Coastal Problems

The major coastal problems in this area include upgrading the water quality throughout the western end of the Sound, improving the safety and efficiency of the existing marine transportation system, satisfying the region's demands for recreation facilities, and managing the shoreline so that those few areas of unique and irreplaceable value are preserved and other areas enhanced and made more accessible.

Water Quality Improvement

While the water area within Subregions 6A and B is the smallest among all the subregions of the Long Island Sound Study–less that 5 percent of the Sound's waters–it is clearly the area with the most significant water quality problem. The primary source of this pollution appears to the the effluent from New York City's sewage treatment plants, borne on the inflow of the upper East River and discharged ultimately into the western end of the Sound. But there are other sources, too: inadequately treated wastes from Westchester County plants, combined sewer overflows caused during heavy rainstorms, oil spillage, leachates from shoreside dumps, and other non-point sources. They all contribute to both the high bacterial count and the massive accumulation of nitrogenous waste, the primary cause of eutrophication and algae blooms. These pollutants, compounded by poor natural flushing at this end of the Sound, have caused severe water quality problems, making the water unsuitable for swimming in some areas and, during the past summer, causing the

prohibition of shellfishing throughout the region.

Construction is presently under way to expand the capacities and upgrade the treatment processes at New York City's four waste water treatment plants on the upper East River. These will provide removal efficiencies better than those of most secondary treatment plants. Completion of these projects will greatly improve the western Sound's water quality.

Westchester communities are serviced by four primary sewage treatment plants. Three of these, the New Rochelle, Mamaroneck, and Blind Brook plants, have offshore outfalls in the Sound which operate successfully. The fourth plant, located at Port Chester, presently discharges to the Byram River, although it is to be provided with deep water discharge—either by sharing the Blind Brook outfall or constructing its own—as part of the program to upgrade it to secondary treatment. The study recommends that all wastewater treatment plants within this subregion be upgraded to at least secondary treatment by 1980.

Another serious problem within this area is the overflow from combined sewer systems, a subject discussed in detail in Section 2.1 Water Management. During periods of rain, several of the combined sewer systems in this area become overloaded and permit partially treated or untreated, although diluted, wastes to enter and therefore degrade the waters of the western Sound. Although these overflows occur infrequently, they generally represent an extreme pollution source with very high coliform counts, BOD loads, and large amounts of floating debris and other solids. To significantly reverse the degradation of the water quality here, effective and economical solutions to each individual combined sewer system problem will have to be sought. New York City, for example, has developed the Spring Creek combined waste treatment plant near Jamaica Bay to test the effectiveness of overflow treatment. Based on the results of this pilot project, there are plans for developing ten similar facilities, six of which would directly benefit the Sound.

Other means of abating the effects of combined sewer overflows can be made through selected improvements to the collection system. Some have already been made in this subregion, but there will have to be others. Among the most cost-effective are combinations of such measures as system replacement or separation, improved maintenance, automated operation, temporary retention, and treatment.

Even after these improvements are made, however, there may still be a significant water quality problem in this area. There is reason to believe, for example, that eutrophication, characterized by frequent algae blooms, may actually increase with the reduction of toxics and suspended solids in the effluent of the upgraded treatment facilities. Many experts have concluded, therefore, that some form of advanced treatment which would remove nitrogen, an important cause of eutrophication, at the municipal treatment plant will be needed. The study has concluded, though, that even with nitrogen removal at all of the municipal facilities, there is no assurance that the eutrophication of the western Sound will cease. In addition to its very substantial cost, advanced treatment would produce increased quantities of sludge. Several of the possible solutions would be extraordinarily expensive (in the billions of dollars) and existing data is not adequate to determine which would be most effective.

Therefore, the study recommends the designation of western Long Island Sound as "water quality limited" and the initiation of a special study for the area. Funded by the U.S. Environmental Protection Agency and administered by the State of New York, it should determine whether nutrient removal at municipal waste water treatment plants will be necessary to attain water quality goals and, if so, how best to accomplish it. This study should not appreciably delay needed action programs, since the prerequisite treatment plant improvements, all of which are underway or awaiting funding, may not all be completed before 1978.

The study further recommends that state and local governments:

- Implement the marine transportation system improvements recommended by the study and outlined briefly below.
- Phase out the existing shore-side landfill operation in Eastchester Bay.
- Provide permanent marine toilet pump-out facilities. Contingent upon the development of federal guidelines, the study has identified the potential for such facilities, to include landing piers, a pump-out device, and appropriate pretreatment facilities, at waste water treatment plants in Port Chester, Blind Brook, New Rochelle, and Mamaroneck. Additional mobile marine toilet pump-out trailers should also be provided at private marinas as needed. Wastes collected at these units can be hauled to and treated at the municipal treatment plants.

Marine Transportation System Improvements

Another potential source of pollution is the hundreds of tankers which carry gasoline and other refined petroleum products in the western Sound. In order to reduce the potential for oil spills, while at the same time enhancing the recreational boating opportunities in this area, the study recommends the development of a pipeline from Bridgeport, Connecticut, to the Bronx by the year 2000, contingent upon the development of an off-shore terminal at Bridgeport. This would significantly reduce tanker and barge traffic at Port Chester and Eastchester Bay. In addition, a new state petroleum receiving and distribution authority should be established to be responsible not only for the development of the New York portion of this pipeline, but also for working with the study-proposed coastal zone management board toward the long-term relocation of existing oil tanks from the shore's edge in Port Chester. This would free these lands for more appropriate shorefront uses.

While some commercial traffic would continue in both harbors, primarily sand and gravel barges, the study's recommendations would significantly improve their appearance and general character, thus enhancing the recreational potential of both. See Section 2.5 Shoreline Appearance and Design, for specific recommendations.

Recreation

Projected increases in this subregion's demand for new recreation facilities are aggravated by the fact that there currently exists a shortage of most of those facilities, including lifeguard protected beach, picnic areas, campgrounds, and boating opportunities.

Traditionally, many of these needs have been accommodated at sites far from New York City, the source of much of the demand. These include the Rockaways, Jones Beach, and Robert Moses State Park on the south shore of Long Island, the southern New Jersey coast, and Bear Mountain State Park in upper New York State.

Many of the study's proposals for new regional parks throughout the study area, therefore, have been developed with convenient access to public transportation, and therefore with New York City residents, in mind. Examples of this type of facility include Silver Sands State Park in Milford and the proposed expansion of Sherwood Island State Park in Westport. The study has also recommended the development of several new parks which have the potential for good transportation connections: Pleasure Beach in Bridgeport (train/ferry) and Caumsett State Park in Huntington (train/minibus/ferry).

Although there is very little undeveloped shorefront land here, the study has developed a number of recreation recommendations — particularly for public beaches — within this subregion. They include:

- **David's Island in New Rochelle.** As part of the Long Island Sound Heritage, David's Island should be acquired for development as a small park. Included in its development would be the preservation of historically and architecturally significant buildings, about 0.8 miles of lifeguard-protected beach, 300 picnic sites, and some transient marina slips. Access would be provided by ferry service from New Rochelle.
- **Hen Island in Rye** should be publicly acquired as part of the Long Island Sound Heritage. It should be preserved as a wildlife management and nature observation area, and could operate in conjunction with the already-owned Marshlands Conservancy, a nearby wetlands complex. Possible future development might include a Classroom by the Sound.
- **Fort Totten in Queens.** As an integral part of the Long Island Sound Heritage, the study recommends the development of a major, multi-purpose recreation facility at Fort Totten, possibly modeled after Mission Bay in San Diego or Toronto's new waterfront park, by 1980. The development of this park should include preservation and rehabilitation of the architecturally and historically significant buildings within the fort; sand nourishment of about three miles of beaches to both the west and south of Fort Totten; 100 picnic sites; a public marina facility, including small boat rental facilities, a limited number of slips and moorings, boat ramps, and a launch service; a parking garage; and a pier for recreational ferry service to Caumsett State Park.
- **Orchard Beach Island.** New York State should actively cooperate with the U.S. Army Corps of Engineers in its ongoing research into artificial islands. Should these studies prove feasible and environmentally acceptable, New York and the Corps should undertake construction of at least one such island, perhaps an Orchard Beach Island, close to New York City, to help meet the swimming, boating, and fishing needs of the urban population by the year 2000. Building materials would include construction wastes from New York City and selected harbor dredged materials as fill. Access to the Island could be provided by recreational ferry service from Orchard Beach.

In addition to these major projects, the study has identified a number of opportunities for smaller scale development, including 1) six boat launching ramps at Rodman Neck, two at Playland Park, and four at the Echo Bay wastewater treatment facility, 2) the expansion of Playland Park by county development of 0.3 miles of already-owned property; and 3) the development of public marinas, with appropriate state and federal aid, including small sail and power boat rentals, launch ramps, hoists, slips, moorings, and launch service in Rye, Mamaroneck, City Island, and Little Neck Bay.

In an effort to insure the continued vitality of the fisheries resource of the Sound and the opportunity for the general public to enjoy it, the study has made a number of recommendations regarding both its management and use. See Section 2.4 Sport Fisheries and Wildlife. Of particular significance in this subregion are those recommendations which would involve:

- The development of three Classrooms by the Sound, marine-oriented programs of environmental education with strong ties to local schools. These would be established in cooperation with the State Department of Education, by New York State's Department of Environmental Conservation, where possible through modification of existing facilities. Classroom locations in Subregions 6 and 3 include the city parks at the southern end of Little Neck Bay, Pelham Bay Park, and the Hen Island-Marshlands Conservatory area.
- The construction of one or more fish piers near the Throgs Neck Bridge and the expansion of the existing piers on City Island.

Shoreline Management

Rather than develop a detailed shoreline plan for each of its nine subregions, the study has set forth in Section Four: Carrying Out the Plan, a legal and institutional framework for effective local and regional management of the coastal zone throughout the Long Island Sound region. Its provisions would have the localities, working closely with appropriate regional and state officials, develop a plan for its coastal zone. Under this proposed arrangement there are a number of tools specified for each of the different levels of government to insure the wise management of the entire coastline of the Sound.

There are a number of specific policy, conservation, and development recommendations the study has made which would represent a significant first step toward the development of a plan for the coastal zone of this region. These proposals are discussed in detail throughout this chapter and summarized in the Map Folio. They include:

- Phasing out of the existing shoreside landfill in Eastchester Bay.
- Relocation of oil tank farms in Port Chester.
- Acquisition and/or development of Playland Park, Orchard Beach Island, Fort Totten, David's Island, and Hen Island.
- Development of recreational ferry service between Fort Totten and Caumsett State Park, Pelham Bay Park and Orchard Beach Island; and New Rochelle and David's Island.

Other Issues

Coastal erosion damages are minimal, due to the nature of the development in this area. Most of the shorefront in Westchester County either is solid ledge rock or contains well protected residential development. The Bronx and Queens shorelines consist largely of well protected commercial or industrial properties. Among the existing beaches, any erosion control measures which would increase the natural capacity of the beach to resist storm caused erosion are not economical from an erosion control viewpoint, as costs significantly outweigh the benefits. While a total of 2.1 miles of potential beach building or beach widening projects have been identified in the study area, erosion control benefits are only about one-tenth of the building costs. When public recreation benefits are considered, however, benefits for such projects can exceed the costs by three to six times.

Flood damages presently amount to $320,000 annually from tidal flooding. However, a recurrence of the 1938 hurricane could cause $3.2 million tidal flooding damage and as much as $9.6 million in 2020. The major portion of the damages would be in Westchester County. This area also sustains the major riverine flood damages, mainly on the Mamaroneck and Sheldrake Rivers and Blind Brook, which amount to approximately $300,000 annually. Damages from a 100-year storm could amount to about $4.4 million. Measures to minimize flood damge are a part of the federal flood insurance program with its prerequisite flood plain development controls. Floodproofing, control of flood plain development, acquisition, and redevelopment are all measures that are considered as alternatives to the acceptance of flood damages, since structural measures generally are not economically feasible.

Water supply does not present a significant problem in Subregions A and B, although projections indicate that there will be a need for additional water by 1990 and 2020. It is anticipated that demands for Westchester County (6A) will be small enough to be readily met by the New York City system. Additional sources are being sought to satisfy the anticipated need for the entire New York City system as demand exceeds the safe yield. Alternatives being considered include construction of new upstate reservoirs, expansion of existing reservoirs, flood skimming, withdrawals from the Hudson River, and expanded aquaduct facilities. Decisions on the appropriate alternatives must be made to the mutual satisfaction of local, county, and state governments, since state-wide resources are involved.

Rail Freight Shipments. In addition to the recommended marine transportation system improvements discussed earlier, the study has made three recommendations with regard to the movement of rail freight which would have an effect on this area:

- Implement the recommendation of the Tri-State Regional Planning Commission for the repair of the Poughkeepsie Bridge crossing of the Hudson River and renew rail freight service over the bridge.
- Reevaluate the potential for a New York Harbor tunnel rail freight crossing between New Jersey and Brooklyn.
- Improve the rail freight service over the Hell Gate Crossing between Bronx and Queens.

Nassau County Subregion 6C

The Setting

There are seventy-seven square miles in this subregion, a little more than one-third of Nassau County's total area, consisting of a series of peninsulas formed by five major bays and harbors: Little Neck Bay, Manhasset Bay, Hempstead Harbor, Oyster Bay Harbor, and Cold Spring Harbor. These harbors generally lie between wooded bluffs which tend to limit access to the sixty-two-mile shoreline almost as significantly as the land ownership patterns in the area do. A large portion of this portion of the northshore is known as Long Island's "Gold Coast."

Shore and inland development in this area is generally characterized by large estates and older, single-family, residential development in both the towns of North Hempstead and Oyster Bay. Shoreline commercial or industrial development here has generally occurred in low-lying coastal areas, particularly at the heads of the harbors and bays: including for example, Manhasset, Hempstead and Oyster Bay.

Nassau County's population increased 94 percent between 1950 and 1960, from 670,000 to 1,300,000. Between 1960 and 1970, however, it grew less than 10 percent, to 1,429,000. Projections for the county indicate a population here of 1,677,000 in 1990 and about 1,800,000 by 2020. These projections represent a marked decrease in the anticipated annual growth rate, from about 6.8 percent per year for 1950-60 and 1 percent per year for 1960-70 to about 0.2 percent per year for 1990-2020.

Since so much of this area is already developed, any new housing to meet this increase in population could be expected to occur through in-filling of isolated vacant parcels in existing areas of development, or through redevelopment of the large estates that may continue to be sold in the coming decades.

Principal coastal activities in subregion 6C presently include some commercial shipping of both refined petroleum products and sand and gravel materials to or from Manhasset Bay, Hempstead Harbor, and Oyster Bay Harbor; extensive recreational boating in and out of the harbors and bays; sand and gravel extraction from the Port Washington sand pits on Hempstead Harbor; and industrial and municipal waste disposal in the vicinity of sewage treatment plants on Little Neck Bay, Manhasset Bay, Hempstead Harbor, and Oyster Bay Harbor.

Major Coastal Problems

The major coastal problems in this area include the provision of adequate and safe drinking water, the upgrading of water quality in the harbors and bays, the expansion of opportunities for recreational enjoyment of the Sound, the development of standards for the rational management of the shoreline, and the improvement of the existing marine transportation system's safety and efficiency.

Water Resource Management

There are two distinct but interrelated water quality problems in Subregion 6C: the pollution of the waters off the shore and in the bays, and the depletion and pollution of the area's ground water system — the source of its drinking water.

Pollution of bay and Sound waters here comes from a number of sources. Perhaps most significant in the Sound itself is the inflow of polluted waters from New York City. Corrective action for this source of pollution is outlined in Section 3.6 Westchester, the Bronx and Queens (Subregions 6A and B). A primary cause of pollution in the subregion's bays and harbors, however, appears to be the seven northern Nassau municipal secondary wastewater treatment plants, which discharge directly into the bays. Poor natural flushing in these bays will continue to aggravate the problem even after those of New York City have been corrected. Non-point source pollution, too, affects the water quality of the bays and harbors of northern Nassau County. These sources include urban runoff, leachates from abandoned shoreside dumps, and vessel discharges.

Pollution and depletion of the subregion's ground water

system is due to two factors. Pollution comes from the practice of discharging household and some industrial wastes into the ground water reservoir. After sewering was instituted to control pollution, ground water withdrawals exceeded natural recharge, because sewers now discharge the treated wastewater to the Sound or ocean instead of the ground. In some areas, the resulting imbalance caused saltwater intrusion from the sea into the ground water reservoir.

Recognizing the relationship between water supply and water quality, the New York State Department of Environmental Conservation held a public fact-finding hearing in 1972 on alternative ground water management strategies on Long Island and their relationship to the state's Pure Waters Program. In response to these issues, the chief executive officers of Nassau and Suffolk counties and New York City designated appropriate officials to meet with the Commissioner of the Department of Environmental Conservation to develop a comprehensive plan for the management of water resources.

Since that time, Nassau and Suffolk Counties, under the Federal Water Pollution Control Act Amendments of 1972, have been designated as a Section 208 areawide waste treatment management planning area. This program, under the direction of the Nassau-Suffolk Regional Planning Board, is charged with the responsibility of developing a comprehensive management program for all of Long Island's water resources by 1977.

An important factor in the comprehensive management of Long Island's water resources is the issue of ground water recharge. Although a large number of laboratory research projects and small pilot studies relating to waste water treatment and ground water recharge have been carried out over the past decade, in-depth knowledge on the enlargement of these projects to full-scale installation is lacking. New York State has therefore applied to the Environmental Protection Agency for a full-scale project for recharging effluent from advanced water treatment facilities to ground water aquifers on Long Island.

The Long Island Sound Study strongly endorses these activities. The study also recommends that Nassau County establish water conservation programs immediately, including more stringent emergency programs in case of drought, to carry it through at least 1990. Measures such as leakage control programs, use of water-saving devices, long-range and wide-spread education programs, revised water pricing with penalties for excessive consumption, and possibly an expansion of the presently practiced storm water recharge program ought to have a major impact. During times of drought, additional temporary (but mandatory) measures such as restrictions on new service connections, automobile and street washing, and watering lawns could be imposed.

Simultaneously, Nassau County, with state and EPA assistance, should vigorously pursue both ground water recharge and sewering to preserve both the quality and quantity of the ground water as its long-term supply source. Neither large-scale recharge nor importation of water from the New York City system appear to be achievable until at least 1985.

Meanwhile, and in addition, the study recommends that state and local governments:

- Implement the marine transportation system improvements recommended by the study and outlined briefly below.
- Construct three extended Sound outfalls from existing and proposed sewage treatment plants, so that effluent is discharged outside northern Nassau's poorly flushed embayments. These outfalls would be shared by all but the Oyster Bay and Roslyn plants. This latter facility is to be abandoned with the wastewater instead pumped to Port Washington. Eventually, Oyster Bay and a new county plant in Bayville would share a Sound outfall. This would be, in part, an interim measure, since longer term ground water recharge is recommended by the study; however, the outfalls would still be available for use during the winter months, during periods of heavy rainfall, and during those periods of breakdown in the recharge system.
- Contingent upon the development of federal guidelines, the study has identified the potential for permanent marine pumpout facilities for boat sewage, to include landing piers, a pump-out device, and appropriate pretreatment facilities, at the following wastewater treatment plants: Belgrave, Great Neck, Glen Cove, and Oyster Bay. Additional mobile marine toilet pumpout trailers should also be provided at private marinas as needed. Wastes collected at these units can be hauled to and treated at the local municipal treatment plants.

Recreation

For the most part, both regional and extra-regional demands for shoreline recreation activities in this area will have to continue to be met by facilities outside of this subregion. Existing natural features, land use, and transportation patterns make it difficult to provide an easily accessible facility, large enough in scale to meet any significant need. An exception to this might be provided by the acquisition of any of the several major shoreline estates and country clubs for limited recreational development, if and as they become available, such as the recent county acquisition of the Pratt Estate in Glen Cove.

In addition to existing regional shorefront recreation facilities at Jones Beach, Robert Moses State Park, and Sunken Meadow, the study recommends three recreational development proposals of interest and significance to northern Nassau County residents:

- **Reclamation of Port Washington sand pits.** As part of the Long Island Sound Heritage, the Port Washington sand pits should be acquired and reclaimed as a major

new shorefront facility by 1980. While certain compatible non-recreational uses might be pemitted along the western boundary and in the interior, the emphasis of the reclamation – particularly near the shore – ought to be the provision of expanded recreational opportunity. The existing town and county parks could either continue to operate within the new park or as part of it. Detailed plans should be developed in concert with the Town of North Hempstead and Nassau County.

- **Fort Totten in Queens** (Subregion 6B) should be developed as a major multi-purpose recreation facility by 1980, as part of the Long Island Sound Heritage. Development here could be modeled after Mission Bay in San Diego or Toronto's new waterfront park. It should include the preservation and rehabilitation of the architecturally and historically significant buildings within the fort; sand nourishment of about three miles of beaches to both the west and south of Fort Totten; 100 picnic sites; a public marina facility including boat rental facilities, a limited number of slips and moorings, boat ramps, and launch service; parking garage; and a pier for recreational ferry service to Caumsett State Park.
- **Caumsett State Park** (Subregion 7) should be developed by the state by 1980 to serve as a regional Long Island Sound beach *and* as a casual recreational facility inland. This park, particularly the Fly Island wetlands complex, would provide an ideal location for a Classroom by the Sound. The shore of Caumsett would provide more than one mile of lifeguard-protected swimming beach. Development of the inland portion of the total park area should be limited, but include the preservation and appropriate reuse of the buildings, about 200 camping and picnic sites. Access to the expanded Caumsett State Park would be provided by only minor improvements to the existing road system, the development of a small mini-bus service from inland parking facilities, and by passenger-only recreational ferry service from Fort Totten and Oyster Bay (near the railroad station) to the existing dock within the cove. In addition, the study recommends a fishing pier as part of the development at Caumsett.

Besides these major facilities, the study has identified a number of opportunities for limited expansion of recreational activities here. They include:

- Development of public marinas in Hempstead Harbor and Oyster Bay Harbor, including small boat rental facilities, a limited number of slips and moorings, launch facilities, boom hoists, and ramps.
- Acquisition and development by the town of Oyster Bay of a section of beach immediately to the west of Stehli Beach as a Class B beach. Class B beaches are eligible for federal financial aid so long as access, including parking, are available to non-residents. A modest admission fee is permitted if it bears some relationship to additional operating and maintenance expenses.
- The county development of the newly-acquired Pratt Estate in Glen Cove.

Shoreline Management

Rather than develop a detailed shoreline plan for each of its nine subregions, the study has set forth in Section Four: Carrying Out the Plan, a legal and institutional framework for effective local and regional management of the coastal zone throughout the Long Island Sound region. Its provisions would have the localities, working closely with appropriate regional and state officials, develop a plan for its coastal zone. Under this proposed arrangement, there are a number of tools specified for each of the different levels of government to insure the wise management of the entire coastline of the Sound.

There are a number of specific conservation and development policy recommendations the study has made which would represent a significant first step toward the development of a plan for the coastal zone of this region. These proposals are discussed in detail throughout this chapter and are summarized in the Map Folio. They include:

- Acquisition, reclamation, and redevelopment of the Port Washington sand pits.
- Reduction in commercial shipping activity in Manhasset Bay and Hempstead and Oyster Bay Harbors.
- The U.S. Army Corps of Engineers should carry out a program of harbor debris cleanup, including the removal of dilapidated or rotting piers, and grounded or rotting vessels in Hempstead Harbor by 1985.
- Recreational development of the Pratt Estate and Fox Point.
- Designation of the village centers of Seacliff, Roslyn, and Cold Spring Harbor as scenic townscapes.

Marine Transportation System Improvements

Since the three major harbors in this subregion, Manhasset, Hempstead, and Oyster Bay, handle primarily sand, gravel, stone, and petroleum products, redevelopment of these harbors depends largely on how these products will be handled in the future.

The study recommends that Hempstead Harbor remain an operating port, handling sand and gravel shipments and residual oil deliveries. However, the amount of traffic generated by sand and gravel export can be expected to diminish as the productivity of the Port Washington sand pits decreases. It is expected the sand pits will be exhausted by 1985.

Additionally, it is proposed that gas and distillate oil deliveries to all three harbors be phased out, thus further reducing traffic and freeing up shorefront land for other water-related developments, such as combined commercial

and recreational enterprises.

The study recommends that gas and distillate be off-loaded from an offshore facility at Port Jefferson in eastern Long Island and trans-shipped via an extension of the existing pipeline at Holtsville to an inland terminal in mid-Nassau County. A fallback option, should it prove infeasible to extend the pipeline into Nassau County, is an offshore berth for Hempstead Harbor, rather than continue or expand significant shipping movements in the harbor. The means for accomplishing either of these plans would be the petroleum receiving and distribution authority recommended for establishment in each state. See Section 2.6 Marine Transportation.

Another advantage of phasing some of the present marine transportation activities out of the subregion's harbors is the opportunity this creates for providing the general public with more access to its shoreline, and for providing a variety of recreational activities. Among the possibilities are recreational redevelopment, in conjunction with residential and commercial use, of Manhasset Bay and Oyster Bay Harbor shorefronts, the addition of a number of marina or public boat rental facilities, and provision of additional onshore recreational fishing sites, particularly in Manhasset Bay, Oyster Bay, and Cold Spring Harbors.

Freight Shipments

In addition to these recommended marine transportation system improvements, the study has made three recommendations with regard to the movement of rail freight shipments which would have an effect on Long Island:

- Implement the recommendation of the Tri-State Regional Planning Commission for the repair of the Poughkeepsie Bridge crossing of the Hudson River and renew rail freight service over the bridge.
- Reevaluate the potential for a New York Harbor tunnel rail freight crossing between New Jersey and Brooklyn.
- Improve the rail freight service over the Hell Gate crossing between the Bronx and Queens.

Eastern Long Island Subregion 7, 8 & 9

The Setting

Subregions 7, 8, and 9 are comprised of Suffolk County's north shore portions of the Sound's surface watershed. In some cases, these areas are very narrow strips. The subregion also includes Plum, Great Gull and Fishers Islands. Excluding these three islands, the total county area within the study boundary is 151 square miles. This represents less than 17 percent of the total Suffolk County land area.

Subregion 7, extending from the Nassau-Suffolk County line to the eastern boundary of Brookhaven, has an area of 130 square miles, 86 percent of the total Suffolk County land area contained in the study area. The shoreline of this area is broken up by several major peninsulas surrounding natural bays and harbors, notably Huntington, Northport, Port Jefferson, and Mount Sinai. Although several large estates remain, land use patterns in this area have begun to reflect the growing development pressures from the west.

Subregions 8 and 9, with relatively small land areas, have a generally uninterrupted shoreline consisting, for the most part, of lightly wooded bluffs, some of which rise to heights of more than 100 feet and have remained relatively undeveloped. Although several large estates and numerous smaller privately-owned parcels still exist in these areas, commercial marinas, recreational facilities, farmland, and energy facilities dominate their shorelines. In the Shoreham area, nuclear power plant construction has altered the shoreline, becoming the dominant visual element in the vicinity. There are four significant ports in Subregions 7, 8, and 9: Huntington Harbor, Port Jefferson Harbor, Mattituck Inlet, and an offshore unloading terminal at Northville. In addition, the Long Island Lighting Company maintains an offshore residual oil offloading pier near its Northport power plant. From Mt. Sinai eastward, with the exception of previously mentioned facilities, the shoreline retains a low-density, open look with scattered seasonal and year-round residences, parks, and other open space lands.

Almost 200,000 people reside in the Suffolk County study area, and over 93 percent of these are located in Subregion 7, the area adjoining Nassau County. This compares with a total Suffolk County population of 1,125,000.

Because of pressures from metropolitan New York and the availability of land in Suffolk County, these subregions are expected to experience a much greater population increase over the next twenty years than other subregions of the study area. The county population is expected to almost double by 1990, to about 2.1 million, and is expected to reach about 2.8 million by 2020. However, most of this population increment will be located outside the study area, due to the general inaccessibility and fragility of the north shore area.

Major Coastal Problems

The major coastal problems in Subregions 7, 8, and 9 include: management and preservation of the shoreline resources in view of pressures for development; meeting the need for regional and extraregional recreational facilities; learning to live with coastal erosion, particularly of the east end bluffs; resolving pressures to supply additional electrical power generation; and improving the efficiency and safety of the marine transportation system.

Shoreline Management

Rather than develop a detailed shoreline plan for each of its nine subregions, the study has attempted to set forth in Section Four: Carrying Out the Plan, a legal and institutional framework for effective local and regional management of the coastal zone throughout the Long Island Sound region. Its provisions would have the localities, working closely with appropriate regional and state officials, develop a plan for its coastal zone. Under this proposed arrangement there are a number of tools specified for each of the different levels of government to insure the wise management of the entire coastline of the Sound.

Of course, there are a number of specific conservation and development policy recommendations the study has

made which would represent a significant first step toward the development of a plan for the coastal zone of eastern Long Island. These proposals are discussed throughout this chapter and summarized in the Map Folio preceding this section. They include:

- Expanded recreation and conservation opportunities through development of Caumsett State Park, acquisition of 0.6 miles of beach at Wading River, acquisition of about 450 acres of bluff and woodland in the Roanoke Point area, and acquisition of about 300 acres in the St. Thomas/Dam Pond area of East Marion.
- Designation and preservation of three special scenic zones, including portions of the Eaton's Neck-Lloyd's Neck area, the Nissequoque-Crane Neck area, and North Fork east of Wading River. Means of preservation should include the use of the 1972 Environmental Bond and the Federal Land and Water Conservation Fund. Local efforts should utilize tax incentives and zoning to encourage scenic preservation.
- Phasing out of port petroleum receiving and distribution activities at Huntington Harbor and Mattituck Inlet, and consolidation and expansion of facilities at Port Jefferson and Northville.
- Development of year-round ferry service between Wading River and New Haven, Connecticut.
- Designation of the villages of Northport, Greenport, Cold Spring Harbor, and Head-of-the-Harbor as scenic townscapes.

Future Recreation Needs

With the expected growth of population in Suffolk County and the anticipated increase in the leisure time that will be generally available to the public, the pressure on the subregion's existing recreation areas will increase, as will the demand for new and expanded facilities.

While there are three state parks along the north shore of these subregions, only two, Sunken Meadow and Wildwood, are developed for public use. The third, Caumsett, is presently undeveloped, in large part as a result of problems in providing automobile access to the park. However, because of the potential for this area to meet a major recreational demand, the study has recommended its development.

Since the shoreline is the main focus of the land portion of this study, and since access to that shoreline is severely limited, the study identified only a limited number of opportunities along the north shore for recreation facilities:

- **Caumsett State Park.** As part of the Long Island Sound Heritage, Caumsett State Park should be developed by the state by 1980, to serve as a regional Long Island Sound beach and a casual recreation facility inland. This park, particularly the Fly Island wetlands complex, would provide an ideal location for a Classroom by the Sound. The shore of Caumsett would provide more than one mile of lifeguard protected swimming beach. Development of the inland portion of the total park area should be limited, but should include the preservation and appropriate reuse of the buildings, and about 200 camping picnic sites. Access to Caumsett would be provided by only minor improvements to the existing road systems, the development of a small mini-bus service from inland parking facilities, and by passenger-only recreational ferry service from Fort Totten and Oyster Bay (near the railroad station) to the existing dock within the cove. In addition, the study recommends the development of a fishing pier.
- **Roanoke Point in Suffolk.** As part of the Long Island Sound Heritage, approximately 450 acres of beach, bluff, and woodlands along Suffolk County's north shore should be publicly acquired by 1985 between Roanoke Landing and Jacob's Point as a recreation and scenic preservation area. A portion of the area, to the back of the bluffs, could be used for camping, hiking, picnicking, and related recreation activities. Access to the beach or to the bluffs themselves, which are extremely fragile and eroding at an alarming rate, would be limited to only two or three pedestrian access points in order to afford them conservation protection.
- **St. Thomas/Dam Pond Area.** The study recommends that 300 acres of land be acquired in the St. Thomas/Dam Pond area of East Marion between 1980 and 1990 and developed as a casual recreation and scenic preservation area. Development could include a beach and, in the inland portions of the site, limited picnicking and camping facilities. As at Roanoke Point, access to the beach or to the extremely fragile bluffs would be limited to a few pedestrian access points in order to afford the bluffs conservation protection.
- **Wading River Beach.** An additional 0.6 mile of beach would be provided by county acquisition and development of a Wading River Beach east of the existing LILCO plant at Shoreham, by 1985. Parking facilities could be provided by leasing land from LILCO. Access to the beach from the parking area could be provided by a foot bridge over the lagoon.
- **Port Jefferson sand spits.** Suffolk County should develop a small recreation passenger ferry service from Port Jefferson to the sand spits at the mouth of the harbor, which are otherwise inaccessible county park lands.

The study also identified a number of opportunities for local acquisition of flood-prone lands for Class B beaches. These areas are characterized by seasonal, residential communities composed, in many cases, of houses structurally incapable of withstanding major storms or of being economically protected. Class B beaches are those municipally owned beaches eligible for federal financial aid

because they are available for use by non-residents. A modest admisstion fee is permitted if it bears some direct relationship to the additional operational and maintenance expenses, and reasonable parking is available. Among the beaches appropriate for Class B status are areas at Asharoken (1.7 miles) in Huntington, West Meadow (1.1 miles) and Mt. Sinai (0.5 mile) in Brookhaven, and Wading River Beach (0.6 mile) in Riverhead.

With the anticipated increases in population, leisure time, and disposable income, the pressure for providing more boat launching sites, ramps, marinas, and pumpout facilities will increase as well. The desire to maintain the present scenic quality of several of the harbors, including Cold Spring, Lloyd, and Stony Brook Harbors, suggests that the only harbors remaining, with significant marina development opportunities, are Port Jefferson and Huntington. The U.S. Army Corps of Engineers, working with the Coast Guard and local harbormasters, should develop detailed small boat harbor studies for these two harbors. However, it appears that private development in Port Jefferson Harbor could provide as many as 1,400 wet storage and 1,200 dry slip facilities for smaller boats, and as many as 800 dry slip facilities for smaller boats in Huntington Harbor.

The demand for boat ramps simply cannot be met in Suffolk County, due to the lack of sheltered launch sites and available parking space, although the multiple use of institutional properties such as King's Park State Hospital in Smithtown could offer opportunities for additional ramps.

As a supplement to the private market and to provide boating opportunities for those who would otherwise not have access to such facilities, the study recommends the development of public marinas in Huntington, Smithtown, Port Jefferson, and Greenport which could include small boat rental facilities, limited slips and moorings, ramps, and a launch service.

Contingent upon the development of federal guidelines, the study identified the potential for permanent marine pumpout facilities for boat sewage at the Northport, Smithtown, Port Jefferson, Mattituck, and Greenport waste water treatment plants. These facilities should include a landing pier, a pumpout device, and pretreatment facilities. Additional mobile marine toilet pumpout trailers should be provided at private marinas as needed. Wastes collected at these units can then be hauled to and treated at the municipal treatment plants.

In an effort to insure the continued vitality of the fisheries resource of the Sound and the opportunity for the general public to enjoy it, the study has made a number of recommendations regarding both its management and use. See Section 2.4 Sport Fisheries and Wildlife. Of particular significance in this subregion are those recommendations which would involve:

- The development of a Classroom by the Sound, a marine-oriented program of environmental education with strong ties to local school. These should be established in cooperation with the State Department of Education, by New York State's Department of Environmental Conservation, where possible, through modification of existing facilities. Possible classroom locations in Subregions 7, 8, and 9 include Sunken Meadow, Wildwood, and Caumsett State Parks.
- The construction of fishing piers at Sunken Meadow, Wildwood, and Caumsett State Parks.
- The construction of artificial fishing reefs in Smithtown Bay and Port Jefferson Harbor.

Coastal Erosion

The topography of the north shore of Suffolk County is dominated by the steep and majestic bluffs along the eastern end. However, these areas are eroding at the alarming rate of one to two feet per year and, in a few sporadic locations, as much as three-and-one-half feet per year. About three-fourths of the county's north shore, or seventy-five miles, has been identified as subject to severe erosion.

In order to minimize this erosion and to preserve the scenic nature of this unique geologic formation, the study recommends that the coastal zone management board, proposed in Section Four: Carrying Out the Plan, designate the bluffs as an area of particular concern, under the terms of the Coastal Zone Management Act, with strict limitations upon the use of and access to these areas. In addition, the study has recommended the acquisition of about 450 acres or three miles of this unique area, in the vicinity of Roanoke Point, and of about 300 acres in the St. Thomas/Dam Pond area of East Marion. Ultimately the county, with state and federal aid, should move to acquire larger and contiguous pieces of this eastern Suffolk bluff area.

Future Needs for Adequate Electric Power

The study has not made recommendations for specific sites of future power plants, since each new facility is subject to detailed review and evaluation requirements well beyond the scope of the study. It has instead outlined a series of policy recommendations to insure the safe provision of energy needs for the future. However, some potential sites for future generating facilities have been identified, subject to detailed review prior to approval, as required by federal and state licensing procedures.

In Subregions 7, 8, and 9, the two primary potential sites identified for additional power generation are located at Jamesport and Shoreham. If the study's recommendations on conservation techniques are fully utilized, additional development may be postponed until more environmentally suitable or publicly acceptable forms of electric power generation are available.

Marine Transportation System Improvements

The major products moving in and out of Suffolk County's north shore harbors are petroleum products, sand, and gravel. At present, such activities occur at Port Jefferson, Huntington, Northville, Northport, and Mattituck. The potential for oil spills from the hundreds of barges and tankers travelling in these subregions annually presents a major pollution problem. In addition, the amount of traffic in and out of the harbors limits their potential for recreational usage, in particularly boating and fishing.

Accordingly the study recommends that:

- An offshore berth for the receipt of petroleum products, except residual oil, should be constructed at Port Jefferson by 1985, with a submarine pipeline to land and then to inland tank farms and the existing pipeline to Holtsville. An interim solution for relieving existing Port Jefferson congestion would be some channel deepening. In order to fully evaluate this option, the U.S. Army Corps of Engineers should quickly complete its current investigation of the feasibility and environmental impacts.
- The present pipeline between Holtsville and Plainview should be extended east to Northville and west to mid-Nassau County by 1980. If it is proved infeasible to extend the existing Plainview/Holtsville pipeline eastward into Nassau County, an offshore berth should be constructed near Hempstead Harbor, with carefully landscaped and limited storage facilities at an appropriate inland site.
- Port facilities other than those located at Port Jefferson, Northville, and the offshore residual pier at Northport should be phased out. This would most significantly affect Huntington Harbor and Mattituck Inlet, both of which would be enhanced for recreational boating.
- New York and Connecticut should consider the development of a year-round ferry service between New Haven, and the Shoreham/Wading River area. Details of the costs and conditions of operation for this and other routes are presently being investigated by the Tri-State Regional Planning Commission. See Section 2.6 Marine Transportation.
- Due to technological difficulties in pumping residual oil ashore over distances greater than two miles, the study recommends that residual oil continue to be both brought into Port Jefferson Harbor in small tankers or barges for use at the power plant, and unloaded at LILCO's offshore facility in Northport Harbor for use at the power plant.

Water Resource Management

For the foreseeable future, Suffolk County has a more than ample ground water supply to meet its present need and future requirements. The exception to this is to be found in the North Fork area where localized pollution of the ground water supply has occurred due to nitrate contamination from individual domestic wastewater facilities.

There are presently three municipal wastewater treatment facilities within this area, two secondary facilities and one primary facility, scheduled for expansion. A fourth facility at Greenport is located outside the study area but an outfall in the Sound is proposed. Continued reliance on secondary treatment methods with Sound outfalls could result in a long-run drop in the water table, whereas advanced treatment methods, coupled with recharge, will ensure preservation of adequate and safe water supplies. Therefore, this study fully endorses the designation of Nassau and Suffolk Counties as a Section 208 areawide waste treatment management planning area as described in Section 2.1 Water Management, and Section 3.7 Nassau County (Subregion 6C).

Perhaps as important as the restoration of polluted waters is the preservation of existing high quality waters. To this end, the study recommends the designation of a number of relatively pristine streams and estuarine areas as non-degradation zones (which prohibit both additional point and most non-point sources of pollution) in order to preserve fish, shellfish, and recreational waters. An example would be Mount Sinai Harbor. In other areas throughout the subregion, the study would urge government officials to protect high water quality areas by severely restricting the development of critical water-related lands such as flood plains, wetlands, and erosion-prone areas.

4.1 An Interim Action Program
4.2 A Longer Range Management Program
4.3 An Index for Decision Makers

4 Carrying out the Plan

An Interim Action Program

Introduction

Earlier chapters document two key findings. First, the Sound and its shoreline face continued threats, deterioration, and lowered usefulness unless a process is established to discuss and disseminate information Sound-wide, and to stimulate increased attention to protection of resources important to people on both shores. Second, because the basic regulatory authority at the water's edge is held by local governments on both sides of the Sound, and because many of the decisions with regard to this area transcend local jurisdictions, it is important to develop coherent and unified policies for its management which recognize both local interests and the interests of communities outside the immediate coastal fringe as well.

To respond to the latter will require some re-orientation of existing institutional relationships. Several management options are presented below. These efforts may be time consuming and could involve much public debate. Nonetheless, the urgent need for a voice for Long Island Sound requires a commitment now to moving an interim program into action.

No one superagency can or should implement the entire Long Island Sound plan. Many people and agencies will be needed to carry out specific parts of the plan. The study has clarified those activities under each recommendation and presents, in Section 4.3, an Index for Decision Makers which shows what each level of government must do to get action on the plan's recommendations.

Moving an Interim Program into Action

Much local, state, and federal effort is already devoted to Long Island Sound and many recommendations for its management are already being carried out, or at least are within existing authority. For the Sound as a whole, however, and for each state's portion of it, there is now no organization to continue to speak for the Sound, to keep on the pressure to implement an effective management program, and to respond to issues of Sound-wide concern.

However, a framework does exist, as set forth in the Coastal Zone Management Act of 1972, within which a process can be established for these activities, and within which local, state, and federal interests can be brought together. The Act recognizes the need to develop inter-agency and inter-governmental coordination in the course of each state's effort to prepare coastal zone plans and management programs and provides financial assistance to do so. In fact, both states have been awarded their grants and have begun planning work. Officials of both Connecticut and New York have indicated their intent to build on the information and findings of the Long Island Sound Study to propose appropriate management activities.

While the present state initiatives in coastal zone management hold great promise that many proposals to protect the resources of the Sound will be translated into action, any effort in this area should include the contribution which can be made by local government. Indeed, because most land use authority rests and will continue to rest with localities along the Sound, any program must acknowledge and solicit the cooperative assistance, and active participation by those local governments. The strong tradition of involvement and competence developed by sub-state regional agencies, especially on Long Island, also provides much experience and expertise which must be drawn upon in the formulation of a management program.

Because the Long Island Sound Study, as one Sound-wide vehicle, ends in 1975, there will subsequently be a crucial period in which actions to implement a balanced management program and to take action on behalf of the Sound should be initiated. There are existing programs to keep many of the activities moving forward. However, during this period interest must be maintained.

An interim follow-on program is required to:

1. Provide the connective link between the Long Island Sound Study and the emerging state activities in coastal zone planning and management. Once state coastal zone management programs are established, the interim program should continue as a forum to discuss Sound-wide issues.
2. Review and evaluate major public or private project

and development proposals having a significant effect on the resource base of the Sound—encouraging appropriate authorities to take specific action, compatible with the policies embodied in this plan. Such an organization could also maintain a "living inventory" of Soundwide problems, such as making the public aware of the extent to which shoreline property is being lost to inappropriate development.

3. Focus attention on those recommendations of the LIS plan which require immediate implementation. It must also stimulate additional research and needed studies to fill gaps in knowledge, and develop information and education programs.

Desirable Characteristics

The characteristics of an effective interim program would include:

1. Staff capability to analyze problems, speak to issues, and specify actions to be taken by others on behalf of the Sound as a whole. Its name should clearly express its identification with Long Island Sound. It should have sufficient professional personnel from existing agencies concerned with planning and management in the Long Island Sound coastal zone made available to it;
2. Strong policy direction and leadership by the two states, since they are ultimately responsible for carrying out much of the plan. There is also a need for a continuing interstate and federal coordinating process as part of any effective coastal zone management program;
3. Adequate expression of the interests of local and county government, and adequate citizen and interest group involvement in that process.
4. Consideration of the planning related to the coastal zone which is being done by local and sub-state regional agencies.
5. Fullest possible use of the reservoir of public and scientific knowledge built up over the past three and one half years, represented in the Citizen Advisory and Research/Planning Advisory Committees.

Options for Programs

1. **Bi-state compact.** The two states could formally agree to establish a bi-state Long Island Sound interim program to be created upon enactment by the respective state legislatures of appropriate legislation. Depending upon the nature of its responsibilities, such an organization may require Congressional approval. The principal objections to this mechanism would be that there are no areas of interstate concern which could not be handled by other means; and the considerable time which would be involved in setting up such an arrangement—probably more than three years. Other problems with the interstate compact approach are described below.
2. **Continuation of a small staff capability from the present Long Island Sound Study within the New England River Basins Commission,** governed by a steering committee of Connecticut, New York and NERBC. This would provide for coordination of state and federal efforts (the Commission includes the Department of Commerce, of which the National Oceanic and Atmospheric Administration, the agency administering the coastal zone programs, is a part) and would provide continuity with the Long Island Sound planning effort. Geographical coverage and legal authority for planning are adequate. Federal funds would have to be secured to match limited state contributions.
3. **Housing an interim program within another regional agency,** such as Tri-State Regional Planning Commission. In some cases a sub-jurisdiction of such an agency would have to be arranged, boundaries might have to be extended, and provision for a federal presence would have to be added. In addition, a comprehensive multi-purpose planning authority would need to be assured, as would the participation of all agencies responsible for taking action.
4. **The existing Long Island Sound Citizen Advisory Committee could be given added responsibilities,** to insure that it continues to speak on behalf of all LIS citizens. A small executive committee could employ a small staff to provide technical services and support. The Research/Planning Advisory Committee could constitute itself either on a co-equal basis with CAC, or as a technical subcommittee to serve as a source of scientific expertise on proposals which might arise. Lack of adequate government participation and limited funds could handicap all but lobbying functions.
5. **An interim coordinating program could be set up by the two states working together within their existing coastal zone planning efforts.** This is tentatively recommended, and is described more fully in the next section. The advantages would be maximum utilization of existing state programs; freedom to take a new approach; ability to coordinate with federal agencies (federal interests could participate on an ad hoc basis); and direct continuity in any state coastal zone management programs that may be approved. Disadvantages could stem from lack of a formal institutional arrangement which could fully consider regional and local concerns.

Recommended Strategy

For ease of transition between the Long Island Sound Study and any longer range management program, and to assure continuity with state programs, the study recommends

that both states, together, establish an interim mechanism with the characteristics set forth above, as part of their individual efforts in coastal zone management. This can be done by each state designating a Long Island Sound program staff as an explicit part of the group performing coastal zone planning at the state level. The mechanism could make full use of the study's existing Citizen and Research/Planning Advisory Committees in order to provide experience and continuity in citizen participation, and to insure adequate concern for Soundwide considerations.

The most expeditious way of creating such a mechanism might be for the state groups involved in coastal zone planning, and the Connecticut Department of Environmental Protection and the New York Department of Environmental Conservation, to develop an interim Long Island Sound Management Program, composed of state and sub-state regional agency representatives, and citizen representatives from the Citizen Advisory Committee. Federal presence could be by invitation of selected federal officials on the committee, provided through NERBC or other channels.

Local representation would have to be obtained. Some suggestions for doing this: special convocation of all affected local governments in order to select representatives, or a "congress of local governments" could be convened by call of the Governors.

Funds could be allocated to this program from the states' coastal zone planning program grants for the support—ideally, in a central location—of one or two staff people for each of the two states and appropriate administrative services. If financial support or in-kind services could be contributed by each state, then perhaps some other form of federal funding could be made available to match this and provide further staff or overhead.

Besides providing continuity among federal, state, interstate and local programs, one additional advantage which such an approach might have is that, once fully developed state coastal zone management programs were in effect, this program, if continued, could provide the necessary linkage between the states to assure bi-state coordination.

Whatever the exact form of an interim program, early action is necessary to bridge the gap between planning and implementation. Efforts to establish such a program should begin immediately and satisfactory guidelines and funding sources should be agreed upon no later than the date of approval and transmission of this plan.

A Longer Range Management Program

General Discussion

A long term, comprehensive management program for Long Island Sound must preserve, restore, and utilize its resources. It must establish and implement compatible policies, criteria, guidelines, and standards for decision-making in the areas of land and water use, and water and air quality.

As pointed out several times, existing state, local, and federal agencies are already doing, or are equipped to do, much of the work. However, one area in particular—the shoreline—provides especially challenging and perplexing issues of conservation, use, access, and development. The critical interface of the land and water, and the nature of governmental authority in the Sound, poses a unique challenge to find an appropriate method to manage those resources.

Furthermore, future use and development of the shoreline will threaten traditional concepts of public rights in the nearshore environment. It is well recognized that a new ethic for land and water is emerging, one which is inherent in an awareness of the interrelationships of the ecosystem, and on which is based the changing concept of the public interest. The ethic is best expressed in the idea that property rights are limited by the reasonable exercise of the police power and eminent domain, and that private property should not be used so as to injure that which is the common property of all the people. These considerations raise the question of whether, in a particular case, regulation of property would constitute an uncompensated taking, without due process contrary to constitutional guarantees.

Plainly, no simple scheme or all-embracing answer is available to reconcile these interests. Clear expression of legislative intent and careful drafting of regulations, based on the current policy and legal decisions in each jurisdiction, will, however, provide a substantial basis for any solution.

In the course of this study, the direction of current legal thinking in this area and the existing political and institutional traditions were considered as a basis for the formulation of altematives and suggested approaches to the management of the Sound. What follows sets forth the existing institutional regime, the criteria and characteristics for any recommended option, an analysis of those options considered, and finally, one approach which the study feels would achieve effective management of the Sound.

Current Responsibilities

Responsibilities for activities which affect the coastal zone involve local, sub-state regional, state, interstate, and federal entities. Since the municipality is a key governmental unit in both states, direct involvement on the part of all local governments in the development and administration of a coastal zone management program is considered essential.

On the substate regional level, the situation differs between New York and Connecticut. In the former, the counties are sub-state districts of long tradition which have been assuming an increasingly meaningful role in the governance of the areas within their jurisdiction. Moreover, all three New York suburban counties bordering on Long Island Sound—Westchester, Nassau, and Suffolk—have governments headed by strong county executives, elected on a countywide basis, and operate pursuant to charters which confer on the three counties stronger powers and greater responsibilities than those traditionally granted to counties under the state county law. On Long Island, the Nassau-Suffolk Regional Planning Board provides an advisory regional perspective of both Nassau and Suffolk Counties, and to the numerous municipalities which make them up. In Connecticut, the only intermediaries between the state and local levels of government are the regional planning agencies, whose function, for all practical purposes, is exclusively advisory. Their membership consists of representatives of local jurisdictions. While they do provide a regional perspective through studies and coordinative recommendations, local representation on their governing boards frequently enables local vetoes of regional necessities.

Even though the two states have a major stake in the restoration and preservation of a high quality environment in, and access to their coastlines, land use decisions within and adjoining them are mostly local. It is only recently

that both states have assumed definitive responsibility for the protection of tidal wetlands. The states are also involved in a multiplicity of regulatory activities aimed at the preservation or restoration of water quality and water supply, abatement of air pollution, and protection of the flora and fauna of each state's maritime edge and waters. In addition, both states own shoreline recreation facilities open to all.

The federal involvement was long largely limited to the traditional role performed by the U.S. Army Corps of Engineers in furthering navigation, flood control, and erotion prevention and control projects. In recent years, however, federal interest has expanded into such areas as fish and wildlife, water pollution, and general protection of environmental quality, giving greater importance to the federal role with regard to the shoreline and waters of the Sound.

Moreover, in 1972, Congress recognized the national interest in, and the increasing demands placed upon, the coastal zone, and passed the Coastal Zone Management Act which asserts that "the key to more effective protection and use of the land and water resources of the coastal zone is to encourage the states to exercise their full authority over the land and waters in the coastal zone." The Act encourages a method of state involvement in coastal zone management, at least by review of areas of critical environmental concern and developments of more than local significance, and authorizes financial assistance to the states for both planning and operation of management programs and the preservation of estuarine sanctuaries. A carefully developed management program of the type envisioned in the Act would offer a significant opportunity to establish a process to enhance and preserve the coastal areas along Long Island Sound.

While the Act does not attempt to dictate either the specific form such a program should take, or the nature of the organizational structure which the states should adopt, it does set some parameters within which the states must operate, as the focal points in any Coastal Zone Management Program (Section 306 (e)(1)(A,B,C). Under these parameters, the states must examine and opt for any one or a combination of the following techniques for control of land and water uses within the coastal zone:

1. State establishment of criteria and standards for local implementation, subject to administrative review and enforcement of compliance;
2. Direct state land and water use planning and regulation; or
3. State administrative review for consistency with its own management program of all development plans, projects, or land and water regulations, including exceptions and variances thereto, proposed by any state or local authority or private developer, with power to approve or disapprove after public notice and an opportunity for hearings.

The federal posture is one of guidance and overview of the adequacy of the processes embodied in the states' management programs, rather than of direct authority over the substance of individual land and water use decisions. The Act also provides that, once an adopted state program is approved by the Secretary of Commerce, federal actions that affect that state's coastal zone must be consistent with its management program. Thus, those Long Island Sound plan recommendations which are adopted by the states' coastal zone programs will govern future federal activities on the Sound.

Characteristics of a Desirable Legal and Institutional Structure

Share authority. A basic aim of the Long Island Sound Study is to determine the manner in which federal, state, and local entities, working in concert, can reach an agreement with respect to solutions of specific problems. A primary need, therefore, is to determine the appropriate sharing of authority by different governmental units. Given the strong home rule tradition in both states, and the historic self-sufficiency of the states themselves, it is clear that, in the last analysis, effective comprehensive land, water, and air utilization and protection programs must be developed by the states in close partnership with the affected local governments.

Develop unified policies. Because the basic land use regulatory power of the state has been delegated through laws enabling its exercise exclusively by the many local governments which line both sides of Long Island Sound, the need is no less important to develop unified policies regarding development and conservation along the maritime edge and in its immediate hinterland. In areas where land use decisions affect the statewide interest, as they do in the Long Island Sound coastal zone, it would be entirely consistent for the state to assert selective and appropriate authority to establish coherent policies such as those listed in Section 2.2 Land Use and Growth, for those issues of greater than local consequence, and thereby strengthen the ability of local governments to deal with issues that transcend their boundaries. This approach has already been initated by both states when they established definitive state control over tidal wetlands.

Public receptivity of substantive participation would be conditional upon the states' assuring (1) that the powers so assumed are directly related to the objectives of a clearly spelled-out coastal zone management program, whose aim is to achieve purposes which are widely accepted and perceived as transcending local interests; and (2) that local governments remain intimately involved in the decision-making process.

Maintain local prerogatives. It is deemed essential, therefore, that in the process of recognizing that the state must become the focal point of a coastal zone management program, any abridgement or abrogation of local prerogatives which is not crucial to the preservation and restoration of the coastal zone environment should be avoided at all costs.

Avoid over-centralization of decision-making. Agreement with this basic premise implies that the model selected

will seek to avoid over-centralization of decision-making in the state, by delegating responsibility to the lowest level capable of discharging it, within a system of accountability under which the state can remain the final arbiter. For the same reasons, the model selected will avoid the creation of additional layers of bureaucracy, and will eschew the amalgamation of functions into an unwieldy agency. And, finally, the model selected should endeavor to utilize existing agencies having sufficient authority to accomplish their mission, and strengthen them to enable them to perform with maximum efficiency.

Insure state interest. Maximum decentralization within a responsive and responsible state-directed framework could be achieved through the establishment of an agency charged with the development of guidelines and standards designed to guarantee that the statewide and federal interests would be protected, but with minimal substantive direct responsibilities.

Clarify nature of activity. The distinction between water-oriented and land-based activities should also be considered within the purview of a Long Island Sound management program. The basic difference between the two is that all water-oriented activities now already fall within the jurisdiction of the two states, thereby covering the entire Sound, and that of the federal government. Land use decisions, on the other hand, are made by a plethora of local governments, with regional coordination only advisory. Direct state jurisdiction is limited to tidal wetlands and related water and environmental regulations. And the federal government is not directly involved.

The lodging of responsibility in a state coastal zone management agency for the setting of guidelines and enforcement of statutes and regulations would be largely superimposed upon, rather than substituted for, the existing structure dealing with water-oriented activities. Unless care is taken, the coastal zone management agency might tend to complicate further an already highly tangled web by singling out state permitting and regulatory activities in a particular geographic area and treating them differently from identical activities in adjacent areas.

This reasoning led to the conclusion that the recommended agency should be primarily concerned with review and regulation of those land use decisions which are crucial to the achievement of essential Long Island Sound management objectives. The establishment of the necessary operational structure and development, and testing of its procedures, will of necessity consume a great deal of time and effort during the intial years of operation of the new agency. During this period, it would be advantageous for it not to be burdened with the need to concentrate a substantial proportion of its resources and executive capabilities on water-oriented permitting and regulatory activities which are already being performed. It should be understood, however, that even following establishment of a new structure, if continued monitoring of the effectiveness of water-oriented regulations by existing agencies show that changes in responsibilities would achieve superior results, including a possible superagency arrangement, appropriate action could be taken.

Delegate responsibilities. Due to the sheer number of local governments which line the two shorelines of the Sound, it is not feasible to delegate substantive responsibility in the critical coastal zone to the local level. The next level closest to the grass roots are New York City and the three counties in New York State, and the five riparian regional planning agencies in Connecticut. In the case of the latter, their investment with substantive delegated powers would be done not in an effort to increase their authority for its own sake. Rather, it would be a device whereby the powers re-assumed by the state would be wielded by agencies maintaining a closer rapport with local governments and organizations than the state government possibly could. Discharge of the state permitting authority through substate agencies could also preclude the growth of a major centralized bureaucratic structure which could not possibly be sufficiently sensitive to the crucial local importance of fine points in the field of land use decision-making. Recognizing, however, that Connecticut's regional planning agencies are tentative organizations with voluntary membership by the towns, any structure which is devised would have to provide for the possible direct assumption by the state of all delegated responsibilities in the event of demise of a regional agency.

Alternative Arrangements

Alternative arrangements for the sharing of implementation powers between the state and local government, at least theoretically, illustrate those considerations that are inherent in various management approaches. While a number of variations were considered, the options fell into the following four broad categories, the last three of which had been suggested by the Coastal Zone Management Act, as pointed out earlier. They include: (1) the establishment of a management program through the creation of a bi-state compact; (2) direct state regulation; (3) the creation of state criteria and standards for local implementation subject to state administrative review; and (4) a mixture of state administrative review for consistency with a state management program and approval of plans or projects for the coastal zone, with local responsibility for the development of plans and regulations.

A bi-state agency compact. One particular institutional form was given thorough consideration because of its apparent simplicity and logic. Since the two riparian states and the federal government all have a legitimate interest in achieving an optimal management program for Long Island Sound, why not establish a bi-state agency joined with the federal government through a compact approved by the Congress of the United States? (An alternative to this would be an interstate compact with the states as signatory parties. Although the federal government would not be a signatory party in this alternative, it would have to approve

the compact. It would have corresponding limitations in areas of federal pre-eminence.) The study recognized that, in recent years, there has been a dramatic increase in federal concern with a number of substantive problems which previously were left almost entirely to the states. This has included a clearly stated federal legislative interest in water quality, air quality, and coastal zone management supplementing the previously declared federal interests regarding fish and wildlife, power, navigation and navigational aids, flood control, recreation, and waterborne commerce.

Since the three-tiered American federal system of national, state, and local jurisdictions make no formal provision for regional jurisdictions, the present institutional framework within which some of the responsibilities in these areas are discharged may well have evolved by default. Since many issues and opportunities are neither confined within the limits of municipal, county, or state boundaries, nor national in scope, they could well be most logically and effectively dealt with in the context of geographic, economic, or cultural (or social) regions. For these reasons, over a period of time, various types of interstate regions have been created for various purposes: for planning and planning coordination (such as the Tri-State Regional Planning Commission and New England River Basins Commission); for encouraging economic development (such as the Appalachian Regional Commission); for periodic meetings on common concerns (such as the Atlantic States Marine Fisheries Commission); for managing a natural resource (such as the Delaware River Basin Commission); and to construct and operate facilities (such as the Port Authority of New York and New Jersey).

The Constitution of the United States requires Congressional consent to all interstate compacts (Article 1, Section 10). As a practical matter, however, as a result of judicial construction over the years, it is generally accepted that compacts need Congressional consent only if they affect the political balance of the federal system, or if they adversely affect a power given by the Constitution to the federal government.

At the federal level, the trend (as illustrated by recent air quality agreements) seems to be to view compacts primarily as instruments for the implementation of federal government objectives. This is a new emphasis, since in the past, it had been thought that interstate agreements were justified and beneficial if they furthered legitimate state policies and met needs of state administration.

Unquestionably, Long Island Sound must be considered as a single body of water even though jurisdiction over it rests in the two states of New York and Connecticut, and several federal agencies have responsibilities therein. The question of whether a single agency should be concerned with all aspects of this single body of water, however, must be considered in light of the major recommendations which have emerged from the Long Island Sound Study. If the measures recommended for the safeguarding and restoration of the Long Island Sound environment can be successfully implemented by each state acting separately and largely using existing governments, departments, agencies, and coordinating mechanisms, the burden of proof of need for institutionalized joint interstate action falls on its proponents. As explained below, no justification for such action was found to be inherent in the present situation, and certainly not before the powers which a bi-state agency would have to be able to wield have gained acceptance on the state level. Also to be considered is the fact that successful examples in this country, like the Port Authority of New York and New Jersey, all involve essentially single-purpose interstate agencies with substantive development and operating responsibilities. There are believed to be in this country no successful examples of interstate agencies with comprehensive concerns and exclusively regulatory responsibilities.* In the Long Island Sound case, the difficulties under which an interstate agency would operate would be vastly increased by the detailed nature of the regulatory responsibilities which must be discharged, especially in the land use and development field, and the comparative ease with which a successful system can be developed by each state, assuming willingness on its part to take on separately its share of the overall task.

The federal mandate to improve and maintain the quality of the nation's waters has been accepted by both states in the form of water quality standards and goals for the short term and long term improvement of water quality. While the rate at which these goals are achieved depends partly on the availability of federal and state funds, the commitment to water quality improvement is firm. There are still unresolved questions, such as the need for nutrient removal, the long term effects of pollution from dredge spoils dumping in the water, and the appropriate treatment for storm water runoff. None of these issues is unique to Long Island Sound. Ever-increasing research efforts are being carried out now, and new technologies, when available, will have to be applied on a case-by-case basis. As for enforcement, the authority already exists, with the federal government occupying a prominent position. What may be lacking at present is sufficient political will to enforce all applicable laws, and this dimension is not likely to be supplied in greater quantity in the context of a bi-state compact.

Coastal zone management has already been authorized by federal legislation, and both states have received planning funds under the federal Coastal Zone Management Act. Those activities, including land use, at the water's edge which may impact upon Long Island Sound could be regulated adequately by each state following appropriate adoption or amendment of state statutes. Any resistance to such regulation which could stymie its effectiveness at

*While the Lake Tahoe Regional Planning Agency is both an interstate and regulatory agency, it is generally accepted that its effectiveness has not been proved, and many think that it will continue to be limited.

the state level would only be magnified by the threat, as objectors would view it, of a bi-state jurisdiction to the point of either precluding its establishment altogether or of rendering it totally ineffective.

For example, the consolidation of ports for the receiving and distributing of waterborne petroleum products does not require bilateral action. Either state could create a non-profit public corporation to construct and operate such facilities without similar action by the other state. Petroleum received in Connecticut ports is consumed almost exclusively within the state, and products delivered to Long Island are consumed there. The selection of locations on the two shores can be performed independently, without in any way changing the effectiveness of the outcome.

Year-round ferry service between the two states would require coordination with many existing agencies charged with local zoning, highways, traffic, waterfront developments, navigation, and safety. Such a development could be best undertaken jointly by the states of New York and Connecticut through a single-purpose, self-supporting or subsidized, bi-state agency, with the power to issue revenue bonds for the purchase of equipment, construction of facilities, and operation of the ferry service. This type of agency framework would not only be simpler, but it would also circumvent the difficulty of prorating shares of costs and benefits to each state.

The adoption of shoreline design standards, using the study's *Shoreline Appearance and Design: A Planning Handbook*, or other scenic design guidelines could be undertaken unilaterally by each of the two states or by individual counties and localities. Joint action is not essential since both shores of Long Island Sound are rarely visible simultaneously except from the air. Furthermore, the geography of the two shores varies greatly for their entire length. Many aspects of the *Handbook* would have to be applied by individual states reflecting their own value judgments.

Many of the other goals identified in the Long Island Sound Study, such as increased public access to the shore and the water, relocation to inland sites of non-water-related industry, and redevelopment of harbor facilities rendered obsolete due to the consolidation of ports, are site-specific, and as such can also be achieved by a variety of agencies in each state. None of these requires simultaneous, joint activity on the part of both states in order to be effective.

Of greatest importance would be the question of bi-state agency financing. Compact agencies have no power to tax. They may obtain revenues through the operation of services, but other than that are totally dependent on annual appropriations by each of the signatory parties. If past experience can serve as a guide, it would appear that major federal contributions on a sustained basis are highly unlikely over the long pull. Yet, if the federal government is a member of the compact (as would undoubtedly be required considering the extent of the federal interest in fish and wildlife, navigation, flood control, recreation, and waterborne commerce), such a compact would be binding on the two states, but not on Congress, which could limit its consent for a number of years, amend the scope or intent of the compact through subsequent legislation, or even revoke the compact altogether.

An agency created by compact would be in no way "another government" or a "fourth level of government." Rather, such an agency would be more analogous to a department in a state government. It would have to report to the Governors and Legislatures, it would have to be audited, it could be investigated, and, while it could qualify for any available federal grants-in-aid, it would have to conform to the same federal laws and regulations as anyone else. At the same time, however, it also would have to be answerable to Congress, and could be required to disclose and furnish such information and data as may be deemed appropriate by Congress or any of its standing committees. A bi-state agency could thus be further removed from accountability to the voters of each of the two states.

The latter is an important potential weakness of a bi-state approach. In the Long Island Sound region there are many publics to be served: those concerned with conservation, those concerned with economic development, those concerned with social values—recreation, aesthetics, and access. The service areas of the various activities which take place in the Sound, or which affect the Sound, vary greatly, and no single definition of the Long Island Sound region is likely to be pertinent to all concerns. The fact that policy would be made by a compact agency would in no way remove such policies from controversy. The same hard decisions and compromises will have to be made. By delegating or relinquishing a portion of their responsibility and power to a compact agency, each state could well create the impression that it is trying to pass the buck, by placing these decisions under a jurisdiction that would be one more step removed from accountability to the electorate. Since the many offices within the New York Department of Environmental Conservation and the Connecticut Department of Environmental Protection actively work with their respective federal counterparts, it would seem that strengthening this structure rather than creating a new and untried structure would yield superior results. The important links are those between each state and the local and federal governments, with the link between the two states being of least consequence to the effectiveness of the overall program.

The possibility that federal planning and management assistance grants might be made available directly to a bi-state agency for its formative period is not a sufficient inducement for the creation of what may become a burdensome, distant, unaccountable, and bureaucratically powerful entity.

As for federal funding assistance for Long Island Sound-related research and action-oriented programs of the two departments, to the extent that funds are available, grants under the Coastal Zone Management Act, Section 701 of the Housing and Urban Development Act of 1954, as

amended, and research grants from the Environmental Protection Agency, National Aeronautics and Space Administration, National Academy of Sciences, and other agencies, are channeled to the states, to existing regional agencies and to relevant university programs, such as the Marine Research Centers at Connecticut and New York universities and the Sea Grant Program.

The above not only does not negate, but in fact affirms the desirability of assuring that the model ultimately chosen will achieve optimal coordination between the two states and the federal government, as well as internally, among all relevant state agencies, between the states and their local governments, and among local governments.

Direct state regulation. A direct state coastal zone regulation system might be implemented by designating the environmental agency of each of the two states as the lead agency to prepare, in co-operation with all other interested state agencies, a plan for a statutorily defined state coastal zone. The plan so developed would specify ecologically fragile areas, proposed major facilities to be located in the coastal zone, and permissible uses in the area. A separate state agency would be responsible for administering the program, and issuing all development permits for any use in the coastal zone, including public and private proposals, based on regulations implementing the state plan. Outside the coastal zone, local governments would continue to be responsible for regulating land use, with the exception that certain specified types of development with an identifiable impact on the coastal zone would be referred for review by the state regulatory department. A notable example of such an approach is the Hawaii Land Use Law.

While this approach would be analogous to the experience at the local level with land use regulation, it would represent an attempt to achieve coherent objectives and goals in coastal zone management and to allow a greater mobilization of resources in land use decision-making.

However, although this approach would provide an expeditious method by which to protect areas of critical concern to the state, it would not be responsive to the existing political realities and traditions of local land use controls. The absence of any local participation and consensus in this model would present a formidable stumbling block to its implementation.

Moreover, its principal flaw lies in the assumption that the state can necessarily do a better job of zoning than local governments can. While state government is undoubtedly best suited to handle some kinds of regulation, because of their nature or scope, it is not at all conclusive that local governments, with some regional co-ordination and technical assistance, cannot capably administer most of the necessary regulations in the coastal zone.

It should also be recognized that the state would be assuming an enormous administrative burden in this approach, and that state zoning would run counter to trends in planning which encourage flexibility in land use decisions. Removing regulation from the dynamics of local response to local conditions, and fitting them into a single state pattern, would therefore seem undesirable.

State standards and local regulation. At the other end of the continuum, a model could be devised which would emphasize a local management program in conformance with state or regional criteria and standards. Again, this model would envision each state's environmental agency establishing program guidelines for regulations which would be appropriate for controlling categories of developments in specified critical areas, the nature of which would have impacts of greater than local consequence. These guidelines would then be used by local or regional governments, which would be required to enact special zoing or subdivision ordinances, development permit programs, or other protective regulations consistent with the state standards for all designated areas within their respective boundaries, and approved by the appropriate state level agency. Only if a local control program were not approved, or not submitted within a given time period, would the state agency have authority to prepare a set of controls for municipal administration. The state agency might also serve an appellate function, reserving any local permit determinations brought by an aggrieved party to the decision.

There is adequate precedent for such an approach in both Connecticut and New York. The Inland Wetlands Program established under Connecticut's Inland Wetlands and Water Courses Act sets forth permitted uses and suggested regulations for these areas. It is left to municipal action to implement the Act by acquisition or regulation of wetlands within its boundaries. In New York, the flood plains management program is structured similarly. Under that Act, the state can provide technical assistance to counties which have been identified as flood prone. This assistance may include the preparation of model flood hazard regulations. If within three months of the date by which a local government must qualify for participation in the national flood insurance program, the state agency judges that the local government has failed to qualify, the agency must develop the necessary regulations to meet federal requirements.

This option would have the advantage of involving both the state and local government in a partnership to designate and regulate areas of environmental concern. Also, it would allow the higher level of government to perform functions which it can carry out most appropriately, while delegating authority to the lower level of government consistent with its more intimate knowledge of local conditions and with traditional concepts of home role and local land use control. Nor would it contravene typical arrangements which already exist in other state programs for natural resource management.

On the other hand, the establishment of such a program would require significant statutory enactments to empower state agencies to set and enforce standards and the ensuing administrative difficulties might complicate existing interagency relationships. Also, because the state is powerless to compel enforcement of local regulations, the implementation of state policy is weakened by the possibility of local

modification and erosion of local authority. Finally, the possible absence of consistent decisions between localities, even though there would be state co-ordination, may not be the most effective method of protection nor the most appropriate approach to achieving regional solutions.

A mixed management model. In order to meld the best of each of the above approaches, this arrangement would rely primarily on local government to plan—within state guidelines—and regulate shoreline uses of local significance. In those areas identified as being of greater than local concern, where what happens in the area may have significant environmental effects, the regulation would be subject to substantive state jurisdiction—excercised by regional instrumentalities. Outside the nearshore area, local regulation would be independent, subject to existing state controls over air and water pollution, and subject to state review of any special activities which could have a significant effect on the coastal zone. The state program would thus be administered by an intermediate agency which could perform or coordinate all important functions in the area. Through a dynamic process, local feedback would influence ultimate decision-making authority. The "ladder" principle would be followed, namely, of moving up one level of govemment if performance at the next lower level did not meet prescribed criteria.

There is much to be said for such a combination. It would economize governmental structure by using the best there is and encouraging the upgrading of other parts. It would seek the greatest involvement by those most affected. The interplay between levels of government would foster consensus and reconciliation of differences. And most important, it would attempt to implement effective, cohesive policies for a critical resource.

Because of these considerations and advantages, the study tentatively concluded that this approach, which incorporated the strengths of the other options, was preferred. It is accordingly presented in greater detail. It should be noted that this is not necessarily the only appropriate solution. Other alternatives might work as well or better, provided that the resulting structure were equal to the task and supported politically, financially, and legally. In any event, both states and their localities will ultimately choose their own preferred management program. The following model is presented for their consideration.

A. Designation of state level coastal zone management entity. Each state, acting individually, could establish a Long Island Sound Coastal Zone Management Group (CZMG) responsible to the Office of the Governor and endowed with sufficient authority and financial resources to enable it to guide the development of an effective coastal zone management program and assure its ultimate implementation. Each CZMG would be staffed by and function within existing state agencies which exercise project review powers. In New York State this could be the Department of Environmental Conservation and in Connecticut, the Department of Environmental Protection. Each could be chaired by a special assistant commissioner for Long Island Sound.

Membership in the CZMG should be structured to insure the participation of those who are most involved in the coastal zone and prevent the domination of any one viewpoint over another. The size of each would be limited to approximately fifteen members. At a minimum, there should be local, state, county (or sub-state agency), and public representation. Public and non-government members should be represented in sufficient numbers to give balance to the group. The structure should also include those state agencies directly and substantially involved in policy formulation in and affecting the coastal zone.

In New York State, there would have to be several such groups covering other coastal areas. State representatives on all groups could be the same, so that the experience gained from one coastal zone could be applied to others. The group covering the Long Island Atlantic Ocean coastline would therefore be the same as that covering its Long Island Sound coastline, less Westchester County. In Connecticut, the LIS-CZMG could be built upon the Coastal Area Management Board established to supervise the state's current coastal zone management study.

B. Designation of substate management entities. Both states could delegate a key planning and management role to a lower level of government—but one which could balance local interest with greater than local needs—an *intermediate agency.* The criteria for selecting such agencies should include: 1) representation of *local government;* 2) participation of *elected officials;* 3) *proportionally representative* membership (i.e. one man, one vote); and 4) adequate *funding and staff* to capably meet delegated tasks. In addition, the study has generally concluded that it is desirable to strengthen existing institutions rather than create entirely new ones.

In Connecticut, since there are no county governments, and because direct state intervention was tentatively rejected above, there appear to be three options for strengthening existing institutions: Regional Councils of Elected Officials (RCEOs), Councils of Government (COGs), and Regional Planning Agencies (RPAs). Both RCEOs and COGs do not exist for all of Connecticut's shoreline localities nor is there any assurance they would be created. The five shoreline RPAs include all of the riparian towns and most of the first and even second tier of localities inland. RPAs are proportionally representative, while both COGs and RCEOs are not—nor should they necessarily be. All three institutions consist entirely of representatives of local government, although only COGs and RCEOs necessarily include elected officials. RPAs may include elected officials if the localities' legislative bodies have so chosen, and if the local planning commissions' delegates were elected. In any event, RPAs could include elected officials by *local* modification of existing laws and without new state legislation. All three institutions would require additional funding and staff, although RPAs are closer to the required levels of both than either of the other two, where they do exist. For all these reasons, the study favors the delegation of the

necessary powers to the five coastal regional planning agencies in Connecticut.

In New York—exempting New York City for the reasons set forth later—it would be possible to entrust the coastal zone management program to the three counties, all of which have strong elected executives and legislative bodies. Optionally, on Long Island, the *intermediate agency* could be the Nassau-Suffolk Regional Planning Board.

This delegation of powers should exclude the two states' powers and responsibilities regarding tidal wetlands along both coasts, which should remain vested in the Departments of Environmental Protection in Connecticut and Environmental Conservation in New York, to be exercised in accordance with the relevant recently adopted statutes.

The delegation of powers to intermediate agencies would have to be coupled with continuing and consistent state financial aid, which could be supplemented with any available federal aid but which should not be dependent upon the vagaries of Congress. The amount of aid would have to be sufficient to assure that program administration will be expert, expeditious, and effective. This is especially important in the case of substate regional planning agencies which lack independent taxing powers. Experience in states where laws authorizing statewide land use decision-making are now in effect, is conclusive regarding the need for a staffing level and specialized expertise considerably greater than that traditionally involved in county or regional planning. If a program of this nature is adopted by the respective states, adequate program funding should be guaranteed.

C. **Common purposes and standards.** The two states could adopt a single statement of purposes, reflecting the overall objectives of a Long Island Sound management program, as well as two well-coordinated and compatible sets of criteria, guidelines, and standards to govern the administration of coastal zone and related regulatory powers by the intermediate agencies. Complete uniformity is not essential, except perhaps with regard to permits and regulations dealing with water-based activities which would tend to cross the territorial boundary between the two states.

D. **Jurisdiction.** Even though the coastal zone, as defined, is limited to a relatively narrow strip along the shore, its effective management requires careful attention to activities not only within, but also beyond its boundaries, when such activities may affect the coastal zone. The system recommended here would combine original jurisdiction by the CZMG, directly or through the intermediate agencies within the coastal zone and review jurisdiction by the intermediate agency of activities beyond the coastal zone, when relevant to the protection or restoration of the coastal zone environment. To be meaningful, such a review should include the overall land use and conservation plans and regulatory systems, including their enforcement, for the entire area of all municipalities bordering on Long Island Sound.

E. **Develop local conservation and development plan.** At the present time, local land use plans are advisory only. They are frequently prepared by appointed bodies whose objectives and policies can be literally ignored by the land use decision-making bodies. It is therefore deemed essential to a system of management, such as the one proposed here, that local land use plans be *officially adopted* by the same bodies which are responsible for making land use decisions. In New York State, this means the local governing bodies, while in Connecticut, it can mean either (1) local governing bodies where special charters entrust them with the zoning power, or (2) combined planning and zoning commissions.*

All municipalities directly bordering on Long Island Sound would, within two years, develop a *conservation and development* plan covering their entire area, or reconfirm their existing plans, modified as necessary. At a minimum, the local plan would contain a comprehensive land use and conservation element and a transportation element. All local plans would be required to identify and designate all *environmentally critical* areas and areas now or potentially providing pulic access to the Sound within their boundaries. The plans would require official adoption by affirmative action of the body responsible for land use decision-making, as discussed in the preceding paragraph. Following such adoption, all local land use regulations and amendments thereto, and all capital improvements, would be required to conform with the plan as adopted, or as duly amended in advance of implementation of any such action. The CZMG, the intermediate agency, or private parties would be empowered to take action to compel enforcement of adopted plans and regulations.

Financial aid toward the preparation of local plans could be made available by the state, with such assistance from federal sources as may be available. To emphasize the freedom of local governments to develop their own plans and regulations, within the framework of state guidelines, technical assistance for local planning and administration of each local portion of the overall coastal zone management program could be made available impartially to all communities, regardless of whether they choose to develop local staff capability, or whether they prefer to secure technical services from the delegate agencies, or from elsewhere.

F. **Review of local plans: new.** The intermediate agencies would be required to review the local conservation and development plan and land use regulations, as to their consistency with state purposes, criteria, and standards, to the full extent of their relevance to the protection and restoration of the natural resources of the coastal zone, and to the provision of public access to the Sound. In the event of a finding that either or both are not so consistent, the locality would be required to modify them or seek a contrary decision from the CZMG. Both the CZMG and the intermediate agencies would be specifically authorized to designate additional environmentally critical areas, wherever they deem it to be appropriate, and to require special care in the treatment of all such areas and of their

*General acceptance of this view would throw into question the validity of continuing separate planning and zoning commissions in Connecticut.

immediate vicinity.

The review of local conservation and development plans and regulations should be a continuing one. The intermediate agency would have the right to initiate appropriate modifications designed to further the aims of the coastal zone management program, on the basis of its monitoring of the cumulative effect of continuing developments within the locality, of new technological or scientific advances, or of changes in public policy. Moreover, consistent with its A-95 review and coordinative responsibilities, such opportunity for review and appropriate modification would be afforded the Tri-State Regional Planning Commission.

G. **Review of local plans: existing.** Pending completion and adoption of local conservation and development plans and corresponding land use regulations, and within six months following their designation as intermediate agencies, such agencies would be required to review all existing land use and development regulations relevant to the coastal zone for consistency with state purposes and the guidelines promulgated by the CZMG. In the event that an intermediate agency found any regulations, covering a specific area within the coastal zone, not to be in furtherance of the state's objectives, it should be authorized to prohibit development in that area until the regulations are appropriately amended or until completion and adoption of the local conservation and development plan and land use regulatory system acceptable to the intermediate agency.

H. **Preparation of local plan by intermediate agency.** In case of failure on the part of any local government to develop and adopt an acceptable plan and compatible land development regulations, within six months following a finding to that effect, or following the two-year deadline, whichever is the later date, the intermediate agency would be required to develop and approve a conservation and development plan for the locality's coastal zone, and for adjacent areas necessary to enable it to properly regulate uses which may have a direct and significant impact on the coastal waters, and promulgate land development regulations consistent with the plan. Following approval, the plan and regulations would have the same effect as if prepared and adopted by the local government, which would be required to enforce them as if they had been developed and adopted by it.

I. **The regional coastal zone plan.** Subject to CZMG review and approval, the intermediate agencies would be empowered to supplement the local plans of conservation and development for the coastal zone with additional elements including, but not limited to, the following:

(1) A regional recreation element;

(2) A regional transportation element, limited to the provision of transportation facilities needed to provide access to existing or proposed facilities or development of statewide concern in the coastal zone only;

(3) A public access element for maximum visual and physical use and enjoyment of the coastal zone by the general public;

(4) A siting element for developments of statewide concern;

(5) A marine mineral and living resources conservation element, including estuarine sanctuaries; and

(6) An educational and scientific use element.

J. **Permit authority.** All development within the coastal zone, except for development of statewide concern and developments which are determined by the intermediate agency to be of only local concern, would be subject to issuance of a permit by the intermediate agency following a public hearing. Such permits would be issued only if, based on a careful assessment of environmental impact, the intermediate agency concludes that the proposed development will not have any substantial adverse environmental or ecological effect, will not have any substantial adverse effect on public access, and such development is consistent with the coastal zone plan. The intermediate agency would also be empowered to impose reasonable conditions to maximize public access to the waterfront, increase available recreation facilities and open space preserves, and minimize any adverse environmental impact.

In given situations, in the interest of achieving maximum flexibility in the pursuit of public objectives, the intermediate agency would be authorized to adjust development yields permitted within the coastal zone under the adopted coastal zone plan, in accordance with pre-adopted guidelines. In this context the intermediate agency would be authorized to use such means as clustering or planned unit developments, transfer of development rights, and other advanced land development regulatory techniques.

Within the coastal zone, unless permits for developments of statewide concern are also subject to the authority of other state agencies under applicable statutes, they would be issued directly and exclusively by the CZMG. In those cases in which a development of statewide concern would be of national interest, the CZMG would be required to send notice of all applications for such developments to the federal government which, in turn, would be expected to notify all other agencies with a potential interest in the proposed development. This type of notice would also be sent to the various interstate agencies for their review and comment as to the proposed action of the CZMG.

Within the coastal zone, even though the permit issuing authority would be the intermediate agency, except for those permits deemed by the delegate agency to be of purely local concern, their review of plans for all proposed developments should take place concurrently with that of the appropriate local authorities. Continued local jurisdiction and plan review is necessary to assure compliance with local standards, such as subdivision improvement standards. While intermediate agency review would be concerned only with environmental impacts affecting the integrity of the coastal zone management program, no approval would issue where an application is disapproved by local authorities due to non-compliance with established local standards.

K. **Appellate function.** The state CZMGs would be empowered to hear and decide appeals brought by any person,

locality, or intermediate agency from any decision of the intermediate agencies, including any finding of non-conformity of the coastal zone plan with state guidelines. Any person aggrieved by a decision of the CZMG would have a right to judicial review, provided a petition is filed within sixty days after such decision has become final.

L. **Shared responsibility: a dynamic process.** Recognizing the possibility that, in communities bordering the Sound, development could have a negative effect on the state's ability to achieve the purposes of the coastal zone management program, even though it were to occur beyond the inland boundary of the coastal zone, the local government would be able to override a disapproval but only by a two-thirds vote of the local legislative body. In case of referral by the intermediate agency to the CZMG and disapproval by the latter, the development as proposed would be prohibited. The intermediate agency could be given forty-five days in which to react and, in the case of referral to the CZMG, the latter could be given an additional thirty days.

M. **Bi-state coordination.** To achieve and formalize the necessary overall coordination, quarterly joint meetings of the two Long Island Sound CZMGs under the alternate chairmanship of the Governors of the two states would be required by statute. Between meetings, a joint executive committee, supported by such permanent staff as may be deemed necessary, could monitor developing issues and prepare agendas and action documents. If the urgency of any particular situation should so demand, either Governor, or both Governors jointly, could be authorized to call special meetings. The interstate coastal zone planning and management interest represented by such agencies as the Interstate Sanitation Commission, the Tri-State Regional Planning Commission, and the New England River Basins Commission, could be insured by their statutorily required participation in the joint CZMG meetings.

If, after a reasonable trial period, it should become obvious that, despite all efforts at coordination, serious policy, program, regulation, or enforcement gaps remain, consideration could again be given to the possible desirability of a bi-state compact.

Other Considerations

1. *Local reliance on the property tax a possible impediment.* Assumption by the state of a substantive role in land use decision-making raises major intergovernmental fiscal issues. Local governments depend upon the property tax for a very high proportion of their income. Deleterious though the practice of fiscally-motivated zoning may have been traditionally, in terms of the feasibility of achieving an orderly and rational approach to areawide land use distribution, the fact remains that abridging a local government's right to increase its tax rolls, especially in a recessionary period which happens to also coincide with a period of escalating public demands, may well interfere with its ability to provide essential services.

Since it is not feasible to institute any directly compensatory state aid program, decision by decision, serious consideration should be given to possible ways of reducing local dependence on the property tax.

2. *The use of tax incentives in the coastal zone.* One of the most creative, yet underutilized, methods of local land use control is that of property tax policy. While a number of new tax programs could be devised as appropriate tools to provide incentives and disincentives for development generally, it is suggested that consideration be given to their special application to the coastal zone.

One method which might be used would involve the valuation of the land, for tax purposes, at the value of its existing use. In another method, land in the coastal zone could qualify for preferential tax assessment. Provision should be made in both methods to prevent abuse and speculation, by the use of rollback and interest charges. Both states have preferential assessment schemes. New York has enacted an agricultural districts law and a law for the taxation of forest lands, while under Connecticut's PA 490, certain land can be classified as forest, farm, or open space and assessed at its current use value.

Expanding beyond those concepts, consideration might be given to extending partial tax abatement for as long as the property is maintained in a natural state. At the time of disposition of the property by its owner at its full development value, refunds in full of all foregone taxes, with interest based on the prime rate on the dates the taxes fall due, year by year, might be placed in a special state land acquisition fund. The logic of channeling the tax refunds into a special state, rather than local, land acquisition fund is based on a recognition that the locality will enjoy the very real benefit of the preservation of the lands in their open state over time, and that the collection of back taxes at some later date would be an additional, unearned benefit which can effectively be used for the permanent preservation of open spaces.

3. *Redevelopment of the waterfront.* Within the coastal zone, the localities would be authorized to broaden urban renewal powers to include the acquisition and redevelopment not only of those waterfront properties which are in substandard condition, but also of those that are significantly incompatible with the coastal zone plan, such as, but not limited to, non-water related industries, existing oil storage facilities following the possible institution of a centralized oil receiving and distribution system, and obsolete piers, as well as premature subdivisions. Since this aspect of the program would be in furtherance of statewide objectives, and would frequently have the effect of diminishing the local tax base, any financial loss incurred in the execution of such a program, beyond any amount that may be covered by any available federal assistance, might equitably be assumed as follows: (1) the loss incurred in connection with that portion of a redevelopment program which results in the creation of public waterfront facilities should be assumed entirely by the state; and (2) the loss

incurred in connection with the creation of a site for private development should be shared, so that the local share would be as low as possible. The redevelopment plan should be subject to approval by the CZMG.

4. *New York City: a special case.* Unlike other counties and regions along the shores of Long Island Sound, New York City already possesses the necessary land use decision-making powers for the entire five-county area within its jurisdiction. This special case should be recognized by charging New York City with all responsibility for the coastal zone management program within its boundaries, subject to generally applicable and strictly enforced state and federal laws and regulations. While the existing powers of New York City should not be abridged in any way, any new powers conferred on intermediate agencies should also be made available to the city.

This treatment of New York City may appear to be inconsistent with the overall purpose of achieving an integrated approach to the management of Long Island Sound, especially in view of the fact that its most polluted waters are those adjacent to New York City's shores. In fact, however, there is believed to be ample justification for such an exception. New York City has long administered a highly complex land use management system. It has formulated enormously costly water pollution abatement plans. Their implementation is being delayed by the absence of funds, availability of which is unlikely to be speeded up by New York City's participation in the overall Long Island Sound management system on a par with all others. As the state accumulates a body of experience in the discharge of its newly-assumed land use control responsibilities, and should it become evident that New York City's exclusion significantly diminishes the effectiveness of the overall management effort, there will be ample opportunity for the State Legislature to expand the system proposed herein to include New York City. The first step in that direction, which might appropriately be taken within three to four years of the establishment of the remainder of the Long Island Sound management system, might be the formulation of mutually agreed upon guidelines and standards to apply to New York City. In developing such guidelines, the special conditions present in the city should be carefully taken into account. For example, even a definition of coastal zone as extending 500 feet inland from the mean high water mark may be vastly excessive on the East Side of Manhattan.

Glossary of Terms

1. **Coastal zone** (for purposes of illustration). That area which extends from the state's territorial limits to the mean high water mark and thence continues inland from the mean high water mark 500 feet, or to the ten foot elevation, whichever encompasses a larger area of land. (*Note:* This definition is one of many possible interpretations of the federal Coastal Management Act definition of coastal zone as "the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder), strongly influenced by each other . . ." Any reasonable variant of the definition used here would be workable for the mixed management model.) The coastal zone is an area of critical state concern. It is an area within which the state deems the interrelationship of development and environmental preservation objectives to be sufficiently critical to require direct state authority over the issuance of all permits for development or modification of the existing state of natural areas.

2. **Coastal zone management group (CZMG).** A group established by the State Legislature consisting of : (1) representatives of state departments directly and substantially involved in policy formulation in and affecting the coastal zone, appointed by the respective department heads; (2) representatives of all county governments abutting Long Island Sound, appointed by their chief executives, and a representative of each sub-state, regional planning agency abutting the Sound; and (3) representatives of local government and the public appointed by the Governor with the consent of the Joint Committee on the Environment in the Connecticut Legislature, and the Joint Committee on Environmental Conservation in the New York Legislature.

3. **Local plan of conservation and development.** The basic unit in the coastal zone plan. To be developed or adapted from existing plans within two years, it would contain land use, conservation, and transportation elements.

4. **Coastal zone plan.** The aggregate of all adopted local plans of conservation and development for the coastal zone as augmented by the intermediate agencies and/or the coastal zone management group, and as approved by the intermediate agencies.

5. **Intermediate agencies.** Groups of municipalities, counties, or regional planning agencies through whom the coastal zone management group exercises most of its direct management functions.

6. **Development of statewide concern.** Public or private development which has a potential impact on the population, economy, or environment of the state as a whole, or major portion thereof, such as, but not limited to, power plants, airports, deep water ports, oil receiving stations, and offshore uses and developments of any kind.

7. **Environmentally critical areas.** Areas containing or having a significant impact upon historical, natural, or environmental resources of major importance; or areas significantly affected by, or having a significant effect upon, an existing or proposed major public facility (see below) or other area of major public investment. To be consistent with the Coastal Zone Management Act, this definition, if adopted, should be termed Areas of Particular Concern.

8. **Major public facility.** A facility, either public or private, intended primarily for service to residents of an area extending beyond the boundaries of the particular locality in which it is situated, such as, but not limited to, an interchange between a limited access and a frontage access highway, a railroad passenger station, a major parking facility

serving a shopping or employment center of more than local significance, an airport used for instrument landings.

9. **Premature subdivision.** A predominantly undeveloped area characterized by obsolete planning and diversity of ownership.

10. **Significant developments.** Non-contiguous developments comprising (1) more than ten residential units; (2) more than 10,000 square feet of enclosed floor area; (3) more than 50,000 square feet of pavement; (4) construction on slopes of more than 10 percent; (5) any substantial modification of existing topography other than such as may be required for the placement of an otherwise exempt building or facility; or (6) any discharge of pollutants other than into a public sewer system.

An Index for Decision Makers

Whatever management system is ultimately adopted for Long Island Sound and the land around it, many different government agencies and individuals will continue to play important roles, if the recommendations of the study are to be implemented.

The solutions to sewage pollution problems, for example, require large appropriations by Congress, which are, in turn, administered by the federal **Environmental Protection Agency**. **State legislatures** must also appropriate their share of these costs, and state agencies must be involved in the administration of these funds. Local governments are ultimately responsible for using the state and federal funds in actual construction projects. They must also appropriate their own money to operate and maintain facilities.

The plan proposes to consolidate petroleum receiving and distribution facilities in five Long Island Sound ports in order to make the system more efficient, reduce the likelihood of damaging oil spills, and eliminate the need for most harbor dredging. This will require **state legislative** action to set up two **Petroleum Receiving and Distribution Authorities**, which would develop offshore unloading terminals, in cooperation with the **U.S. Army Corps of Engineers**, build new pipelines, acquire land to develop inland storage tank areas and, with the **U.S. Coast Guard**, set limits for the size of tankers that would be allowed to come into the Sound. In addition, **Congress** is asked to enact legislation requiring the licensing of crew members on boats used for hauling and pushing barges, and to appropriate funds to enforce both this and existing laws. The **Coast Guard** should establish sea lanes into the five ports, and expand their inspection and enforcement operations. Legislation requiring the use of spill containment equipment is a **state** matter, while **private** companies engaged in petroleum operations on the Sound must purchase the equipment and conform to its legislatively-prescribed use.

Like these two recommendations of the study, many others will require active partcipation by different groups of people. This section lays out in handy chart form the major recommendations of the Long Island Sound Study which await implementation by all levels of government and by private interests as well. It will serve as an interim guide for getting on with the job, and is a good indication of the need for vigorously promoting the Plan for Long Island Sound.

ACTOR	RECOMMENDATION					
	Complete secondary wastewater treatment plants by 1980.	Abate pollution from combined sewer overflows.	Study nutrient enrichment in western Sound.	Establish non-degradation zones.	Strengthen dredge spoil disposal procedures.	Reduce oil pollution.
Congress	Appropriate additional funds under Section 201 of P.L. 92-500; amend law to extend deadline from 1977 to 1980.	Appropriate additional funds under Section 201 of P.L. 92-500 for federal cost sharing of most cost-efficient means in individual situations.				Enact legislation requiring licensing of crew members on boats used for hauling barges; appropriate additional funds to enforce existing legislation.
Federal Agencies	*EPA:* Administer program; approve grants subject to provision of appropriate public access at facilities and new rights-of-way.	*EPA:* Provide technical and financial assistance; administer program.	*EPA:* Provide funding for study.	*EPA:* Develop and adopt national guidelines on non-degradation under P.L. 92-500, Section 304.	*EPA, NOAA, COE:* Participate with both states in developing more specific dredge spoil disposal procedures and standards. *EPA:* Provide funds to the states to monitor long-term environmental effects of Sound disposal under Section 106 of P.L. 92-500.	*CG:* Adopt administrative regulations; establish sea lanes to ports in Sound; and enforce regulations and inspect operations with increased funding and staffing.
State Legislatures	Appropriate additional funds as required to provide state share of construction costs.	Appropriate additional funds as required to provide state share of construction costs of the most cost-efficient means (separation and treatment; storage and treatment; etc.) in individual situations.			Enact legislation creating coastal zone management mechanism (see separate LISS recommendation).	Enact law requiring spill containment equipment at each oil port; increase funding to enforce existing legislation; create Petroleum Receiving and Distribution Authorities to consolidate ports (see separate LISS recommendation).
State Agencies	*NYDEC, CTDEP:* Process grants; provide financial assistance; insure appropriate public access.	*NYDEC, CTDEP:* Process grants, provide financial and technical assistance.	*NYDEC:* Participate in and provide appropriate funding for a special study of nutrient removal at wastewater treatment plants and significance of point/non-point pollution in western Sound.	*NYDEC, CTDEP:* Designate high quality coastal waters, streams, and estuarine waters as non-degradation zones; regulate through their "NPDES" Programs.	*CZMGs:* Strengthen the exising bistate "Memorandum of Understanding" to provide more detailed procedures and standards for spoil disposal, assign specific sites for disposal as required, and conduct monitoring operations.	*NYDEC, CTDEP, State Police:* Enforce existing and proposed regulations with increased funding and staffing.
Local Government	Design, construct, and operate treatment facilities; provide local share of construction costs; provide appropriate public access to facilities and new rights-of-way.	Design, construct, and operate facilities. Provide local share of construction costs.	*New York City:* Conduct special study and integrate with ongoing "208" program.	Identify candidate zones; adjust adjacent zoning.	Select and provide sites for land disposal of clean dredge spoils materials consistent with COE and EPA guidelines.	
Other		*RPAs:* Examine extent of and alternative means (separation and treatment; storage and treatment; etc.) of abating pollution from combined sewer systems as part of "208" studies. (See separate LISS recommendation.)	*Interstate Sanitation Commission:* Participate in study.	*RPAs:* Identify and evaluate candidate zones as part of "208" studies. (See separate LISS recommendation.)		*Oil Shipping Companies:* Purchase and utilize spill containment gear.

ACTOR	RECOMMENDATION				
	Control non-point pollution.	Control pollution from shoreside landfill operations.	Control boat pollution.	Multiple use of water utility land.	Establish Areawide Waste Management ("208") Programs.
Congress					
Federal Agencies	*EPA:* Conduct research and demonstration projects; require analysis of non-point sources of pollution and their control in all "areawide" studies conducted under the provisions of P.L. 92-500, Section 208. *SCS:* Provide technical and financial assistance to states and local governments for development of local land management practices which control non-point pollution.	*SCS, EPA:* Provide technical assistance for locating and reclaiming dumps and landfills.	*EPA, CG:* Implement and enforce proposed standards and regulations for vessel wastes. *EPA:* Provide financial assistance for pretreatment facilities.	*SCS, FS:* Provide technical assistance for multiple use management of public and private utility owned watershed lands. *EPA:* Develop multiple use standards.	*EPA:* Approve grants, administer program.
State Legislatures			Enact legislation requiring agency and citizen compliance with new federal regulations.	Enact law providing for first municipal, then state, "right of first refusal" on surplus water utility lands, in exchange for preferential tax treatment; appropriate funds for purchase of surplus lands and shared development expenses on non-surplus lands.	*(GOVERNORS):* Designate waste management areas, approve areawide program applications.
State Agencies	*NYDEC, CTDEP:* Compile and supplement regional analysis of non-point pollution; develop guidelines for local land management controls which would abate non-point pollution.	*Solid Waste Recovery Programs:* Relocate operations from the shore as upland sites become available.	*NYDEC, CTDEP:* Require pumpout facilities at appropriate Sound-side wastewater treatment plants; provide financial assistance for pretreatment facilities.	*CTDEP, CTDPH:* Participate in determination of surplus watershed land; enforce multiple use standards; administer surplus watershed land acquisition and development program.	*NYDEC, CTDEP:* Identify management areas and encourage communities to join together in program area application; provide technical assistance to groups of communities seeking program grants; coordinate areawide programs.
Local Government	Adopt appropriate land use controls, based on state guidelines, to meet local conditions.	Inventory landfill operations; develop land use controls to restrict private shoreside landfill operations; reclaim abandoned shoreside landfills.	Develop pumpout and pretreatment facilities integral to appropriate new wastewater treatment plants; require mobil pumpout facilities at appropriate sites.	Provide preferential tax assessment in exchange for right of first refusal on surplus water utility-owned lands; participate in determination of surplus water utility lands.	Initiate process for areawide designation; apply for program grants.
Other	*RPAs:* Analyze the sources and means of control of non-point pollution as part of "208" studies (see separate LISS recommendation).		*Boaters:* Use holding tanks or other "zero-discharge" devices. Pay minimal fee for each pumpout.	*RPAs:* Conduct studies of utility-owned surplus lands; develop plans for utilization of both surplus and non-surplus water utility watershed lands. *Water Utility Companies:* Provide right of first refusal in exchange for preferential tax treatment; participate in development of multiple use management plans for watershed lands.	

ACTOR	RECOMMENDATION				
	Coordinate and monitor pollution clean-up schedule for Long Island Sound.	Protect and conserve future water supply sources.	Guide and control growth on the shore.	Guide and control growth in "special opportunity" areas.	Create Long Island Sound Heritage.
Congress					Appropriate $50 million to fund up to 75% federal share for state planning and acquisition at selected sites around the Sound. Grants should be conditioned on state development of facilities to National Park standards.
Federal Agencies	*EPA:* Participate with states in utilizing the "continuing planning process" under P.L. 92-500, Section 303(e), as an approach to coordinating water quality management and pollution abatement priorities; approve grants for and administer program of trend monitoring to determine cumulative pollution conditions as provided under Section 106 of P.L. 92-500.	*COE:* Identify potential supplies in need of protection as part of ongoing NEWS activities; recommend appropriate means of protection.	*OCZM:* Approve and fund state coastal zone plans and management programs, under P.L. 92-583.	*HUD, SCS:* Provide technical and financial assistance to state and local governments for land use planning. *HUD, EPA:* Condition grants-in-aid upon development of regional or "areawide" plans directing development to appropriate areas and away from "special opportunity" or critical environmental areas.	*BOR:* Administer federal funds; approve planning and acquisition grants. *NPS:* Review state development plans for consistency with National Park standards.
State Legislatures		Enact legislation to encourage regional water supply system interconnections, subject to state health department review.	Enact legislation creating coastal zone management structure (see preceding chapter for details of LISS proposal).	Enact legislation requiring the development of regulations and incentives to protect "special opportunity" or critical environmental areas.	Appropriate state share of funds; enact law officially recognizing the Heritage as an open space system.
State Agencies	*NYDEC, CTDEP:* Utilize "continuing planning process" under P.L. 92-500, Section 303(e) as an approach to coordinating water quality management and pollution abatement priorities; expand existing programs to monitor pollution with grants provided under P.L. 92-500, Section 106.	*NYDEC, NYDPH, CTDEP, CTDPH:* Adopt and implement policies and regulations for land use to protect and conserve water supply sources; examine opportunities and plans for water supply system regionalization.	*NYDEC, CTDEP:* Adopt interim policies governing the use of shore land (see Land Use chapter). *CZMGs:* Prepare coastal zone plans with local governments and regional planning agencies.	Develop guidelines and incentives to protect "special opportunity" areas; provide technical and financial assistance to regional and local agencies to identify and protect critical environmental areas, and to plan for guiding growth to areas capable of accommodating it.	*NYOPR, CTDEP, LISPC:* Develop plans for, acquire, develop, and manage land designated as part of the Heritage.
Local Government		Develop, adopt, and enforce land use regulations consistent with state policy to protect future water supply sources.	Adopt interim policies governing use of shore land and regulate those areas accordingly; prepare coastal zone plans with state and regional agencies; adopt design standards as part of building and zoning regulations (see *Shoreline Appearance and Design: A Planning Handbook*).	Adopt protective regulations for critical environmental areas; amend zoning ordinances to encourage clustering in appropriate areas.	
Other	*Interstate Sanitation Commission:* Participate with states in monitoring programs.	*RPAs:* Assist state and local governments in identifying potential water supply sources and opportunities for system regionalization. *Water Utility Companies:* Participate in identification of potential water supply sources; develop system interconnections.	*RPAs:* Adopt interim policies governing use of shore land; prepare coastal zone plans with local and state governments.	*RPAs:* Develop general plans of conservation and development which would guide growth to appropriate areas and away from "special opportunity" or critical environmental areas.	

ACTOR	RECOMMENDATION				
	Improve boating opportunities and safety.	Improve recreation opportunities on the shoreline.	Increase access points to the Sound.	Develop inland recreation opportunities.	Improve transportation access to recreation facilities.
Congress	Appropriate funds for small boat harbor feasibility studies in Long Island Sound by the COE; enact legislation requiring safety certification of boat operators in interstate waters.	Enact legislation requiring full public access, subject to safety and capacity constraints and only a minor non-resident surcharge to facilities funded with federal grants-in-aid; amend authorizing legislation for COE participation in beach nourishment work to permit projects for recreation only.	Enact legislation to provide the COE with such authority as may be necessary to conduct a special study of the feasibility and environmental impacts of the development of an artificial island in the western Sound, and if appropriate, to construct it upon completion.		
Federal Agencies	*BOR:* Provide financial assistance to local governments to develop public marinas under the Land and Water Conservation Fund (P.L. 88-578. *COE:* Initiate small boat harbor feasibility studies to determine extent of improvements needed for recreational harbors. *CG:* Participate in small boat harbor studies; enforce boater safety certification laws.	*All Agencies:* Condition awards of grants-in-aid to provision of public access. *COE:* Conduct feasibility studies for and artificially nourish selected Long Island Sound beaches. *BOR:* Provide Land and Water Conservation Fund grants to states and localities for upgrading existing facilities.	*BOR:* Administer the Land and Water Conservation Fund (P.L. 88-578), giving special consideration to proposals which would preserve or expand existing public access to the Sound. *COE:* Conduct special study of artificial island construction in the western Sound.	*BOR:* Provide financial and technical assistance to state and local government for recreational opportunities under Land and Water Conservation Fund (P.L. 88-578). *SCS, FS:* Assist state and local governments in identifying additional opportunities for recreation on forest and agricultural land.	*DOT:* Provide financial and technical assistance for recreational ferry service and other means of mass transit to, and appropriate terminal facilities for, public recreation facilities.
State Legislatures	Amend existing legislation to require safety certification for all boat operators.	Enact legislation requiring full public access, subject to the safety and capacity constraints of the facility and only a minor non-resident surcharge, reflecting the marginal costs of operation and maintenance.	Appropriate funds for state cost sharing in the acquisition and/or development of shoreline mini parks; create or replenish existing bonded funds for appropriate state cost sharing of shorefront land acquisition or development.	Enact legislation giving the state a right of first refusal for private recreation areas in exchange for preferential tax treatment; appropriate or bond funds to acquire and develop recreation land.	Appropriate funds for state share of recreational ferry service and other transportation facilities for access to recreation.
State Agencies	*NYOPR, CTDEP:* Provide state share of financial assistance to local governments for public marina development, under the Land and Water Conservation Fund.	*All Agencies:* Condition grants-in-aid to provision of public access. *NYOPR, CTDEP:* Upgrade selected existing facilities, provide technical and financial assistance (using both state funds and Land and Water Conservation Funds) for upgrading local facilities; identify potential sites for beach nourishment.	*NYDEC, NYOPR, CTDEP:* Participate in surveys of past and present public access points to shore; provide technical and financial assistance in development of shoreline mini parks and other shorefront public open space.	*NYOPR, CTDEP:* Acquire and/or develop inland sites with recreation potential to divert some of the demand from the shore; purchase lands with potential for linking park and open space areas (see Land Use and Critical Natural Resources Map).	*NYDOT, CTDOT:* Initiate studies of mass transit service to recreational facilities; develop and operate or franchise recreational ferry service. *CTDEP, LISPC:* Repeal regulations limiting bus parking and access at state parks; develop mini bus or jitney systems for access to state parks via existing parkways.
Local Government	Appropriate local share of the cost and develop public marinas (including small sail and power boat rentals). *Harbormasters:* Participate in small boat harbor studies. *Police:* Enforce boater safety certification laws.	Provide general public access to recreation facilities funded with state and federal financial assistance; upgrade selected existing facilities; identify potential sites for beach nourishment.	Participate in surveys of past and present shoreline public access points; acquire and/or develop shoreline mini parks at about five mile intervals along the shore.	Acquire and/or develop prime inland recreation sites; require dedication of open space or easements from developers in areas of potential linkage (see Land Use and Critical Natural Resources Map).	Participate in studies of mass transit service to recreational facilities.
Other			*RPAs:* Conduct surveys of past and present public access points to the shore; make recommendations regarding potential public reuse.		

ACTOR	RECOMMENDATION				
	Improve cross-Sound transportation.	Consolidate and improve receipt and distribution of oil.	Improve visual access to the shoreline.	Preserve and enhance areas of special scenic concern.	Establish state minerals extraction policies.
Congress	Amend Federal Highway Act of 1956 (23 USCA Section 129 (g)) to allow federal financial assistance for interstate ferry service which connects to an interstate or primary highway.	Enact legislation limiting the size of tankers entering Long Island Sound to no more than 150,000 dead weight tons and 55 feet in draft.		Enact legislation authorizing COE harbor debris removal outside of navigational channels.	
Federal Agencies	*DOT:* Provide technical and financial assistance for ferry service and improvement of rail freight connections. *CONRAIL:* Operate and maintain improved rail freight system.	*COE:* Coordinate and assist in development of offshore unloading facilities; complete investigation of channel deepening at Port Jefferson Harbor; dredge New Haven Harbor to a depth of 40 feet; maintain other channels as indicated. *CG:* Enforce legislation limiting size of tankers in Long Island Sound to 150,000 dead weight tons or 55 feet in draft.	*BOR:* Administer Land and Water Conservation Fund (P.L. 88-578 to provide federal financial share for purchase of development rights in scenic areas. *DOT:* Provide technical and financial assistance to states for purchase and development of scenic overlooks.	*SCS, FS:* Assist state and local governments in identifying prime agricultural and forest lands, including areas of special scenic concern. *COE:* Carry out program of harbor debris clean-up in selected Sound harbors.	*BOM:* Provide technical assistance to states in developing or strengthening state minerals extraction policies. *USGS, COE:* Participate in joint study of marine mining feasibility with states.
State Legislatures		Enact legislation establishing Petroleum Receiving and Distribution Authority (PRDA) to develop needed facilities in each state.	Appropriate state share of funds to acquire scenic overlooks and scenic areas.	Amend existing historic district legislation to allow inclusion of scenic townscapes as protected areas; provide funds for scenic preservation through bond acts.	*Committees on Environmental Protection:* Monitor implementation of state minerals extraction policies–if ineffective, legislatures should enact legislation providing for preemptive zoning (in exchange for preferential tax treatment) to insure mineral resources.
State Agencies	*NYDOT, CTDOT:* Solicit competitive bids from private operators to establish ferry service operation; provide technical and financial assistance for improvement of rail freight connections.	*PRDAs:* Develop offshore unloading terminals; construct and operate new pipelines; acquire and develop sites for new tank farms; phase out selected shoreside tank farms over the long run, giving first preference at new tank farm sites to relocatees.	*CZMGs:* Develop access element in respective State Coastal Zone Plans; adopt site selection planning and design criteria for major shoreline developments. *NYDOT, CTDOT:* Identify and acquire rights to scenic overlooks along state and federal highways.	*NYDEC, CTDEP:* Designate developed areas of scenic importance and recommend to local government appropriate design controls. *CZMGs:* Develop register of critical natural, scenic, and historical areas, and promulgate regulations to preserve them.	*NYDEC, CTDEP:* Establish state standards for regulation of mineral extraction operations under a permit system (implementing N.Y. Mined Land Reclamation Law); conduct joint study of marine mining feasibility.
Local Government		Redevelop abandoned shorefront tank farm sites.	Adopt the design criteria of *Shoreline Appearance and Design: A Planning Handbook* as part of local building and zoning codes; develop regional historic and scenic tour guides; identify and acquire development rights to important scenic view points.	Identify and acquire title or easements to important scenic areas; identify and designate scenic townscapes; redevelop blighted waterfronts using current urban renewal powers and funds available from the Community Development Act (P.L. 93-383) or the Coastal Zone Management Act (P.L. 92-583).	Adopt local regulations which conform to state standards to allow mineral extraction.
Other	*Tri-State Regional Planning Commission:* Complete current study; provide continuing technical assistance to states in developing service; re-examine Hudson River rail tunnel crossing.		*RPAs:* Adopt as policy design criteria for significant developments proposed within viewing radius of shoreline ("regional viewshed").	*RPAs:* With state CZMGs, develop register of critical areas.	

ACTOR	RECOMMENDATION					
	Restore abandoned mining sites.	Regulate electric power facility development.	Develop incentives to conserve energy.	Develop fish research and management programs.	Protect wildlife habitats.	Develop Classroom by the Sound environmental education programs.
Congress	Enact legislation providing for Long Island Sound Heritage, one unit of which is the reclamation of the Port Washington sandpits (see earlier recommendation).	Enact legislation requiring interagency and state coordination for power plant siting and licensing.	Enact legislation establishing tax incentives for private conversion to new energy sources.		Appropriate funds for wildlife management area acquisition.	
Federal Agencies	*SCS, USGS, BOM:* Provide technical assistance to develop reclamation plans.	*ERDA:* With state involvement, establish early site designation procedures for nuclear power plant location; participate with national standards organizations in expanded effort for development of design standards for nuclear power plants.	*FEA:* Initiate an energy conservation program with both states; establish regional conservation goals; develop a public awareness program.	*NMFS:* Develop management programs for bluefish and striped bass; participate in Long Island Sound resident species research and management program; conduct research on and develop more intensive aquaculture methods for shellfish management.	*FWS:* Assist states in establishing a natural areas preserve/wildlife refuge system with funding under the provisions of 16USCA 777 *et seq.* and 669 *et seq.*	*HEW:* Administer environmental education program grants under the provisions of P.L. 91-516. *NMFS, FWS:* Provide technical assistance in developing course materials.
State Legislatures	Appropriate funds to assist in reclamation of mined-out lands	Enact legislation creating an interagency review board in each state to provide one-stop licensing procedures for power plant siting; enact legislation providing for a fund to underground selected overhead transmission lines.	Enact legislation establishing tax incentives for private conversion to new energy sources.	Appropriate funds to conduct fish management programs.	Appropriate state share of funding for wildlife management area acquisition.	Appropriate funds to assist in the development or purchase of facilities (laboratories, boats, etc.) for the Classroom by the Sound environmental education programs.
State Agencies	*NYOPR, CTDEP:* Reclaim abandoned sites with funds provided by tax on tonnage extracted in state. *NYOPR:* Participate in reclamation of Port Washington sandpits.	*CZMGs, NYPSC, CTPFEC:* Adopt electric power facility site selection and design criteria; require utilities to provide appropriate public access at shorefront facilities.	*NYPSC, CTEO:* Establish statewide conservation goals; develop a coordinated energy conservation program; formulate guidelines for utility expenditures for research and development programs.	*NYDEC, CTDEP:* Conduct resident species research and management program; monitor shellfish beds for proper management; exercise power to revoke leases; develop guidelines for shellfish bed restoration and more efficient production methods; develop pilot projects for growing shellfish with sewage waste.	*NYDEC, CTDEP:* Acquire and develop a natural areas preserve/wildlife refuge system; establish wetland creation and rehabilitation programs. *CZMGs:* Develop regulations for the management of a 300-foot buffer zone around marine wetlands.	*NYDE, CTDE, NYDEC, CTDEP:* Assist in development of Classroom by the Sound programs.
Local Government	*Nassau County, North Hempstead:* Develop reuse plans for pilot reclamation at Port Washington sandpits.		Develop municipal energy conservation goals.	Manage shellfish beds through leases; restore selected closed areas for production of shellfish.	Regulate development in the 300-foot wetland buffer zone.	Conduct Classroom by the Sound environmental education programs consistent with state guidelines and with funds provided by state and federal grants.
Other	*Sand and gravel mining operators:* Reserve funds for reclamation of mined-out lands.					

ACTOR	RECOMMENDATION	
	Reduce damage from floods.	Control erosion and sedimentation.
Congress		
Federal Agencies	*SCS:* Develop selected flood control plans; conduct flood hazard analysis studies. *HUD:* Administer insurance programs; provide emergency assistance. *COE:* Develop selected flood control plans; provide emergency assistance; participate in pilot flood plain management studies. *NWS:* Conduct research to modify and predict hurricanes.	*SCS, FS:* Control agricultural and forest losses through structural and non-structural methods; provide technical assistance to state and local governments for prevention of erosion and sedimentation. *COE:* Dredge selected channels; conduct wave energy and dissipation project with N.Y.
State Legislatures	*CT:* Enact legislation providing for state establishment of local flood plain regulations upon failure of locality to adopt regulations. *NY, CT:* Appropriate funding for participation in pilot flood plain management studies.	Appropriate funding for maintenance of existing beach control structures.
State Agencies	*NYDEC, CTDEP:* Participate in pilot flood plain management studies; provide technical and financial assistance to localities to reduce damage from floods, provide emergency assistance, and regulate flood plains.	*NYDEC, CTDEP:* Develop guidelines for control of urban erosion and local land use controls; inspect and maintain existing beach control structures. *NYDEC:* Participate in erosion administration projects with COE. *NYDOT, CTDOT:* Develop guidelines to prevent roadbank erosion.
Local Government	Identify and support solutions for flood-threatened areas; develop local flood plain management plans consistent with state and federal guidelines; provide emergency assistance; qualify for and participate in national flood insurance program.	Adopt local land use controls consistent with state guidelines to prevent erosion and sedimentation.
Other	*NERBC:* Conduct pilot flood plain management studies.	

KEY TO ABBREVIATIONS IN INDEX FOR DECISION MAKERS

BOM:	Bureau of Mines, U.S. Department of Interior
BOR:	Bureau of Outdoor Recreation, U.S. Department of Interior
CG:	Coast Guard, U.S. Department of Transportation
COE:	Corps of Engineers, U.S. Department of the Army
CONRAIL:	Consolidated Rail Freight Service (Proposed)
CTDE:	Connecticut Department of Education
CTDEP:	Connecticut Department of Environmental Protection
CTDOT:	Connecticut Department of Transportation
CTDPH:	Connecticut Department of Public Health
CTEO:	Connecticut Energy Office
CTPFEC:	Connecticut Power Facilities Evaluation Council
CZMGs:	Study-Proposed Coastal Zone Management Groups for each State
DOT:	U.S. Department of Transportation
EPA:	U.S. Environmental Protection Agency
ERDA:	Energy Research and Development Administration
FEA:	Federal Energy Administration
FS:	Forest Service, U.S. Department of Agriculture
FWS:	Fish and Wildlife Service, U.S. Department of Interior
HEW:	U.S. Department of Health, Education, and Welfare
HUD:	U.S. Department of Housing and Urban Development
LISPC:	Long Island State Park Commission
NERBC:	New England River Basins Commission
NMFS:	National Marine Fisheries Service, U.S. Department of Commerce
NOAA:	National Oceanic & Atmospheric Administration, U.S. Department of Commerce
NPS:	National Park Service, U.S. Department of Interior
NWS:	National Weather Service, U.S. Department of Commerce
NYDE:	New York Department of Education
NYDEC:	New York Department of Environmental Conservation
NYDOT:	New York Department of Transportation
NYDPH:	New York Department of Public Health
NYOPR:	New York Office of Parks and Recreation
NYPSC:	New York Public Service Commission
OCZM:	Office of Coastal Zone Management, U.S. Department of Commerce
PRDAs:	Study-Proposed Petroleum Receiving and Distribution Authorities
RPAs:	Regional Planning Agencies
SCS:	Soil Conservation Service, U.S. Department of Agriculture
USGS:	Geological Survey, U.S. Department of Interior

5.1 Introduction
5.2 Environmental Impact Statement
5.3 Reviewing the Plan

5 Evaluating and Reviewing the Plan

Introduction

This section contains an explanation of how alternative solutions were evaluated in the process of choosing the final recommendations. It also includes a "broad program" Environmental Impact Statement, as required by the National Environmental Policy Act. And finally, it sets forth the major comments on the plan received during an exhaustive public and governmental review process, together with the staff response in each comment area.

It should be noted that the minutes of all public meetings, copies of prepared testimony submitted at those meetings, and copies of all correspondence received during the public review period, have been submitted under separate cover to the U.S. Water Resources Council for transmittal to the Council on Environmental Quality. In addition, tapes of all eight public meetings are on file at the offices of the New England River Basins Commission, 55 Court Street, Boston, Mass.

Because each recommendation was thoroughly evaluated for its probable environmental, economic, and social impacts, the entire series of reports containing the plan and all background material developed constitutes an Environmental Impact Statement. Thus, the EIS that follows is actually a guide to the various impacts evaluated in each section of the plan itself.

Evaluating the Plan

Each alternative was evaluated conscientiously for its environmental, economic, and social impacts throughout the planning process. Environmental, economic, and social considerations were explicit in the wording of every objective for each function, in the evaluation of every alternative measure, in formulating three alternative plans for each function, and in finalizing all recommendations.

The planning reports, from which this main report is drawn, carry the detailed reasoning as to why each alternative was chosen. Briefly, each alternative was evaluated against fifty criteria. The number varied slightly depending upon subject. These criteria were synthesized from guidance obtained from many sources. Most notable among the sources were:

–The Principles and Standards (PAS) of the U.S. Water Resources Council.

–Various guidelines for the preparation of environmental impact statements (EIS) required under the National Environmental Policy Act of 1969 (NEPA). The EIS requirements were also incorporated by the Water Resources Council in its formulation of the PAS.

–The Coastal Zone Management Act of 1972.

–The Long Island Sound Plan of Study.

–Guidance from the New England River Basins Commission staff.

–Concepts developed by study participants.

By far the most significant of these sources was the PAS. For example, the criteria used corresponded with the four "accounts" required by the PAS. The environmental criteria correspond to the environmental quality (EQ) account. The economic criteria correspond to two accounts–national economic development (NED) and regional development (RD). The social criteria correspond to the account on social well-being.

For each function, up to seventy alternative measures were evaluated with respect to the objectives for the four accounts, using the fifty criteria. The product was a matrix listing the criteria and accounts down the side and the alternative measures across the top. This means that as many as 3,500 separate evaluations were made for each function. These evaluation matrices are included in the original planning reports.

The following section on environmental impacts is cast in the form of the environmental impact statement required by NEPA. It is worth noting that the plan, in explicit agreement with NEPA, incorporated environmental considerations and analysis from the beginning, as an integral part of the planning process. The integration of environmental factors is reflected throughout the final report as well as in this section.

Two important points should be understood about the scope and format of the environmental impact statement contained in this report:

(1) Scope. This environmental impact statement is of

the type known as a "broad program statement," applicable to a group of actions relating to a single geographic region and evaluated in a general and overall manner, and assumes that detailed analysis of component parts may be necessary at a later date. According to the guidelines for preparation of environmental impact statements[1], "where more than one agency . . . is involved in a group of actions directly related to each other, because of their functional interdependence and geographical proximity, consideration should be given to preparing one statement for all the federal actions involved . . ."[2] "In many cases, broad program statements will be required in order to assess the environmental effects of a number of individual actions on a given geographical area . . . Subsequent statements on major individual actions will be necessary where such actions have significant environmental impacts not adequately evaluated in the program statement."[3]

This EIS is such a program statement. It is recognized that as each of the recommended actions is moved toward the action stage, many of them will require further study, hearings, and environmental impact statements. For certain specific recommendations, the hydrologic, geologic, or oceanographic data are inadequate to assess the environmental impact. Such information will have to be collected as part of subsequent Level "C" studies.

(2) **Format.** The reader can cross reference other sections of this report volume to obtain more detailed descriptions of the environmental impacts of proposed actions as well as economic and social effects. The report itself, especially Sections Two and Three, contains more elaborate descriptions of the impacts of individual actions. The final statement included here makes some of these cross references more specific.

1. 38 Fed. Reg. 20550-20562, August 1, 1973.
2. *Ibid.*, Sec. 1500. 7(b).
3. *Ibid.*, Sec. 1500. 6(d).

Environmental Impact Statement

Environmental Impact Statement
(Summary)

Long Island Sound Regional Study
Connecticut and New York

( ) (X) Final Environmental Statement

Responsible Agency:
New England River Basins Commission
270 Orange Street
New Haven, Connecticut 06511

1. Name of Action (X) Administrative
( ) Legislative

2. **Brief Description of Action.** The New England River Basins Commission is submitting to the U.S. Water Resources Council, for transmittal to the President and by him to the Congress, a plan of action balancing the needs to protect, conserve, and wisely develop Long Island Sound in Connecticut and New York, and its related shorelands as a major economic and life enriching resource for the region's people. A study of the waters, lands, biology, and people of the Sound, and the problems created by the mixture of those factors, has been completed. A plan is recommended to solve these problems, with a focus on 1990 needs against the backdrop of long-range, fifty-year needs. Recommendations are made in the following areas: water quality and water supply; land use and open space; recreation; sport fisheries and wildlife; shoreline appearance and design; marine transportation; electric power; commercial fishing; mining; flood damage reduction; and, erosion and sedimentation. Parts of the states of Connecticut and New York are particularly affected, including parts of the following counties: (Connecticut) Fairfield, New Haven, Middlesex, New London; (New York) Westchester, Bronx, Queens, Nassau, Suffolk.

Environmental Impacts. Recommendations have impacts and were evaluated for the following factors: environmental quality, including natural beauty; land (erosion, sedimentation, and land use patterns); water quality and air quality; ecological systems, including terrestrial plants and animals, aquatic plants and aquatic animals (anadromous cold water resident species and warm water resident species); scarce resources including archeological-historical, biological, and geological.

Adverse environmental effects were found for each of the above factors for at least some of the recommended measures. However, these were generally outweighed by concomitant beneficial environmental effects for those same factors for other of the recommended alternative measures, so that there were no net adverse environmental effects.

Alternatives. For each of eighty recommendations, an average of four alternatives were evaluated. There were ten subject areas of study and approximately 500 alternatives analyzed, ranging from a non-structural, non-regulatory approach to various scales of development, projected to meet clearly foreseeable needs. These alternatives are summarized in the body of the environmental statement.

Comments Requested. Comments and views have been requested from the Governors of each of the New England states and New York, the head of each federal department or agency, each interstate agency from which a member of this commission has been appointed, and over 100 local agencies and interest groups. List is contained in the main report of the Long Island Regional Study, of which this statement—broad program type—is a part.

Draft Statement to CEQ: December 3, 1974.

Final Statement to CEQ: [To be submitted by the U.S. Water Resources Council at the time of transmittal to the President and the Congress]

Description of the Proposed Action

Water quality. The report recommends a special study of eutrophication and the need for nutrient removal in the western Sound, increase of federal funds to provide for construction and upgrading of sewage treatment plants to

no less than secondary treatment by 1980; minimization of combined sewer pollution by control of infiltration and inflow; computerized system control, storage, treatment, and limited sewer separation in nine cities by 1985; joint bi-state/federal determination of dumping procedures to mitigate environmental harm of dredge spoils disposal; measures to lessen the frequency of oil spills by consolidating ports and relying more heavily on pipelines (see 2.6 Marine Transportation); offshore terminals at New Haven, Port Jefferson, and Bridgeport; requiring licensing of all key crew members whose ship is used for hauling or pushing tank barges; establishment of sea lanes to major ports in the Sound; requiring that spill containment equipment be available at each receiving port and in use during all transfer operations; and increased funds and staffing for enforcement. Also recommended are non-degradation zones to preserve fish, shellfish, and recreational waters; measures to control non-point sources of pollution; termination of shoreside dump and landfill operations; institution and enforcement of the proposed federal standards and regulations for vessel wastes; adoption of siting and design criteria for new or expanded electric power plants along the coast; and better coordination of the water pollution cleanup schedule in the Sound.

Water supply recommendations are to establish water conservation programs in Nassau County, encourage the development of regional water supply systems, develop new and expanded supplies, and protect water quality in the upper Housatonic River for possible future water supply in southwestern Connecticut.

Water quality and supply management recommendations are to establish areawide water management programs in seven areas, initiate trend monitoring programs in the Sound, and establish joint bi-state/federal priorities for pollution abatement programs in the Sound (see 2.1 Water Management).

Land use recommendations include concentrating development in compact enclaves where new growth along the shoreline is permitted; requiring review and approval by greater than local governments of all significant developments along the maritime edge, a zone extending from the water's edge some 250 to 1,000 feet inland, the boundary ultimately to be defined by the states; review and approval by appropriate non-local governments of other developments with significant impact on the Sound (see Section Four: Carrying Out the Plan). Recommended coastal management policies include preserving remaining natural areas; clustering and concentrating any new development permitted at the water's edge; discouraging new and relocating existing non-water dependent development; sewering only existing developed areas along the shoreline; and designing streets near the Sound to provide scenic views. An integral part of this coastal zone management is the provision of increased public access to the Sound. To accomplish this the following are recommended: establishment of a Long Island Sound Heritage Group—the last opportunities to acquire and/or develop coastal lands for conservation, recreation, and wildlife. These lands epitomize the geological, biological, and historical heritage of the Sound, and are identified in 2.3 Outdoor Recreation; state acquisition of additional shoreline mini-parks at an average of one every five miles for casual use; declaration of state policy to assure adequate public access, over the long run, to the Sound; and a survey of historical and present access to the Sound. Away from the shore, special opportunity areas should be protected through a variety of regulations, acquisitions, and economic incentives, to be exercised by all levels of government (see 2.2 Land Use and Growth).

Recreation recommendations include acquisition and/or development of 19 sites of particular recreation, scenic, or conservation opportunity for inclusion in the Long Island Sound Heritage Group, including: three undeveloped state parks, two existing state parks, four urban state parks, eight islands, and four undeveloped, large waterfront parcels. Feasibility of sand nourishment at these and all beaches open to the general public should be studied. Recreational ferry service to nine islands and parks from urban areas is recommended. Study of creation of an artificial recreational island off Orchard Beach is recommended. Other recommendations include provision of federal funds for scenic site acquisitions; participation in federal flood insurance program to provide open space; local transportation improvements to enhance these scenic sites; operating subsidies and purchase of basic capital assets for operation of a funded facility; a recreation and conservation bond in Connecticut; and local improvements of two beaches (2.6 miles). To ease some pressures on the Sound and enhance the regional open space, nineteen sites, totalling 9,700 acres, are recommended for additions to the state park system in Connecticut. Facilities would include 5,000 picnic sites and 1,050 primitive campsites. At state facilities, all limits on buses should be eliminated. Municipalities should be encouraged to open their parks and beaches to all during the week. Boat ramps should be developed as multiple use opportunities on developed lands. Limited recreation facilities should be developed on water utility lands. Public marinas, including small sail and power boat rentals, launch ramps, hoists, slips, moorings and launch service, should be developed in fifteen locations in the region (see 2.3 Outdoor Recreation).

Sport fisheries and wildlife recommendations include establishment of a shellfish management research program; establishment of a resident species management research program for winter flounder and tautog (blackfish); establishment of a migratory species research management program for bluefish, striped bass, and Atlantic weakfish; development of additional marine-oriented environmental education centers. To provide increased opportunities for fishermen, recommendations include: increased fishing access to existing sea structures; construction or improvement of fishing piers at twelve locations in New York City, Mamaroneck, Stamford, Norwalk, Bridgeport, New Haven, New London, and at the state parks on Long Island; construction of artificial reefs in seven urban harbors in con-

junction with fishing piers; a program to encourage use of presently underutilized species, such as skate, cunner, sea robin, mussels, and conch. For recreation and enhancement of wetlands, recommendations call for restrictions on development within 300 feet of wetlands, rehabilitation of several hundred acres of wetlands, and restoration and wetland creation using dredge spoils and marsh grass plantings of an additional hundred acres. Acquisition of Chimon, Andrews, Dodges, and Menunketesuck Islands as part of the Long Island Sound Heritage Group for use as preserves and wildlife management areas is recommended, as is periodic cutting and thinning of woodland areas, and promotion of old-field succession on former farmlands to insure species diversity (see 2.4 Sport Fisheries and Wildlife).

Shoreline appearance and design recommendations include development of state public access plans, for visual as well as physical access; initiation of high priority programs for scenic preservation and conservation of six quality corridors; adoption of site selection, site planning, and design criteria for significant developments affecting the coastal zone; establishment of state registers of critical areas; natural, scenic, and historic protection of scenic townscapes; improved design standards for streets near the Sound; and public education and awareness programs to increase appreciation of the region's scenic and cultural resources. In order to enhance blighted urban waterfronts, harbor debris cleanup programs in five harbors and redevelopment or removal of blighted areas and eyesores are recommended (see 2.5 Shoreline Appearance and Design).

Marine transportation. Port consolidation is recommended as follows: offshore berths are to be developed to receive refined petroleum products at New Haven (1985), Port Jefferson (1985), and Bridgeport (1990), with submarine pipelines to shore. Full use is to be made of existing pipelines, while recommended new clean product lines include extending the existing Holtsville-Plainview line on Long Island east to Northville and west to mid-Nassau County by 1980, adding a second line from New Haven to the Hartford area by 1990, and running a line from Bridgeport to the Bronx by 1995. Hot lines from New Haven to Middletown and Bridgeport to Devon are recommended by 1985. New Haven Harbor should also be deepened to forty feet by 1990. This would leave only five significant ports in the Sound. Petroleum terminals and traffic, except for residual oil, at other locations would be phased out. Tank farms are to be relocated inland. This entire program would be implemented by a new petroleum receiving and distribution authority in each state with bonding and condemnation powers. High-speed, year-round ferry service between New Haven and Wading River should be encouraged by both states (see 2.6 Marine Transportation).

Electric power recommendations are for active state promotion of energy conservation, continued provision of the study area's present share of the larger service area's generating capacity, reliance on nuclear energy for most base load additions until suitable new forms of energy production become available. Also recommended are provisions for recreation at new generating sites, additional pricing studies to determine ways to distribute costs more equitably, one-stop procedures for power plant sitings, mandatory design standards for new power plants, and undergrounding of selected overhead transmission lines in conjunction with urban redevelopment (see 2.7 Power and the Environment).

Commercial fishing recommendations emphasize a shellfish management/research program to increase the production and harvest of oysters and clams, by making long term deep water oyster bed leases available, monitoring public beds to prevent overfishing, studying the possibility of intensive aquaculture, revoking unused shellfish bottom leases, a feasibility study for growing oysters with sewage treatment wastes, new criteria for closing shellfish beds, and identifying areas where a small modification in sewage handling might result in opening beds (see 2.8 Commercial Fishing). Other improvements in commercial fishing should result from the resident species, migratory species, and wetlands management programs (see 2.4 Sport Fisheries and Wildlife).

Sand and gravel mining and shipping recommendations include statewide standards for local mineral extraction regulations, uniform regulations for sequential land use, mining operations and site reclamation; reclamation of the Port Washington sand pits at a cost of $10 million with redevelopment primarily for recreation, and possibly for housing, commerce, and industry; a marine mining feasibility study; preservation of rail transportation links necessary to distribute minerals from production sites to consumption areas; and the reclamation of selected abandoned mining sites for recreation (see 2.9 Mineral Resources and Mining).

Flood damage reduction recommendations include adoption of local flood plain management regulations; promotion of flood insurance and recognition of the impact of the National Flood Insurance Program; small watershed riverine flood control projects, including dams, channel work, and land management measures. For tidal flooding, one pilot flood plain management study in each state; evaluation of alternative structural and non-structural solutions at seven locations; reservation of funds for redevelopment of twelve flood-prone areas for local recreation; and increased research efforts to achieve a capability to modify hurricanes are recommended, as well as improved forecasting, warning, and evacuation methods (see 2.10 Flood Damage Reduction).

Erosion and sedimentation recommendations are to accept most coastal erosion damages; continue harbor maintenance dredging; require adoption of land use controls for urban erosion; implementation of soil conservation plans for agricultural and forest lands and along roadbanks; and encourage research into wave energy dissipation systems (see 2.11 Erosion and Sedimentation).

Probable Impacts of the Proposed Action on the Environment and Adverse Environmental Effects Which Cannot be Avoided

As mentioned above, net environmental impacts of the plan are expected to be strongly beneficial. Environmental analysis was an integral part of the planning process. Evaluation of alternatives with respect to environmental criteria is woven throughout all analysis contained in the main report and the feeder reports to the study. However, a listing of the gross beneficial and adverse environmental impacts is included here, with a concentration on the impact on ecological systems such as wildlife, fish, and marine life.

Water quality and supply. Increasing the secondary treatment program will enhance water quality in all Sound embayments and in the western Sound, offset slightly by increased amounts of sewage sludge with consequent possible land disposal and air quality problems. Nutrient enrichment and eutrophication will remain as problems, and some scientists believe eutrophication will accelerate as turbidity is reduced. Treatment of combined sewer discharges will improve water quality in many locations. The environmental impacts of the dredging policy and port consolidation will be to improve water quality in the Sound's harbors by reducing liklihood of tanker groundings and oil spillage. Establishment of dumping procedures will mitigate environmental damage and assist in determination of long term effects (if any). All oil pollution recommendations will have beneficial environmental effects, with no offsetting adverse effects, as will establishment of no discharge zones. The study of nutrient enrichment in the western Sound will have no immediate environmental impacts. Vessel waste control will improve water quality for swimming and fishing in all Sound embayments. Termination of shoreside dumps will improve water quality in many streams and harbors, and non-point source control will decrease these sources of pollution. Reliance on water conservation for Nassau County on Long Island will protect both the quality and quantity of the ground water. Future large-scale recharge could insure an adequate drinking supply, but might be prevented if feasibility studies find either contamination of the aquifer by nitrates, viruses, or other potential pollution and health hazards, or technical inability to sustain high-rate recharge. In either event, the county would have to look to outside sources to import water. Development of regional systems will provide less risk of local shortages and less need for development of new sources. Protection of Upper Housatonic River will prevent environmental degradation (see 2.1 Water Management).

Land use recommendations will preserve much of the region's open space, presently constituting 68 percent of the total land area. Creation of a coastal management zone is expected to result in preservation of more areas in natural condition than would be expected without the management zone. It is possible, however, for local and regional governments to increase the proportion of land devoted to industrial, commercial, and residential uses, although this is not expected. In any event, total amounts of land in each development category cannot be predicted with certainty, and such predictions are not within the scope of this study. All remaining recommendations tend to preserve open space and areas of scenic or critical environmental concern. The policy of removing non-water dependent activities from the shoreline can be expected to have adverse environmental impacts in the places to which these industries are relocated. The presumption is that they will be relocated to areas of lower environmental quality than the shoreline. Again, however, this cannot be predicted with certainty.

Urbanization can increase the magnitude of floods, reduce groundwater discharge, and affect water quality. The plan's recommendations for controlled growth will mitigate these impacts (see 2.2 Land Use and Growth).

Recreation recommendations will subject some areas now free from human visitation to increased impacts on soil, water, land, and wildlife, but these impacts are expected to be below what would happen by 1990 without the plan's recommendations. For example, adding islands to the Long Island Sound Heritage will probably increase visitation and environmental impacts in certain areas of the islands above what the impact is today. However, *not* adding the islands to the group could increase unregulated activity, commercial, or residential development, with adverse impacts on the ecological regimen on the islands. Increased legal access will lessen the need to create new beaches, and thus lower net environmental impacts, although leading to slight but widely distributed increased impacts on the Sound's shoreline. Likewise, reliance on ferry service and foot and bike paths for transportation to recreational facilities will increase impacts in the areas of the ferry terminals and foot paths, while drastically decreasing impacts and energy consumption if reliance were placed on cars and private boats.

The artificial island could have adverse impacts which might or might not outweigh benefits derived from adding recreation, shoreline fringe area for littoral species, and aesthetic benefits. Negative impacts would include: possible restrictions on tidal circulation and flushing of polluted water and erosion or deposition patterns; obliteration of bottom habitat; interference with present views of adjacent property users; temporary problems associated with placement of fill (and with removal of fill from source area).

Recreation marinas could have adverse impacts, if not mitigated by strong enforcement of regulations, from overboard discharges of fuel, human waste, garbage, dredging, and dredged spoil disposal (see 2.3 Outdoor Recreation).

No adverse environmental impacts of the **sport fisheries and wildlife** recommendations or the **commercial fishing** recommendations are expected, net or gross, with the possible exception of minor impacts at increased fishing access points. Increased harvesting on a commercial basis,

if properly managed, should result in higher yields without any detrimental environmental effects. Increased sport fishing for presently underutilized species should actually enhance species diversity (see 2.4 Sport Fisheries and Wildlife and 2.8 Commercial Fishing).

No adverse environmental impacts were determined for any alternatives in the **shoreline appearance and design** segment of the plan (see 2.5 Shoreline Appearance and Design).

Marine transportation. All environmental impacts were considered fair to good, with the exception of channel maintenance and improvements which result in unavoidable short term, local adverse environmental impacts on shellfish by resuspending polluted bottom sediments, and increased siltation. Offshore berths, expansion of existing facilities, consolidation of existing storage, and ferries are expected to have moderate to minor environmental impact. Port consolidation, for example, would reduce vessel trips and oil spillage, while at the same time increasing acreage and related transportation facilities required in the immediate area of the remaining ports (see 2.6 Marine Transportation).

Electric power. Additional generating plants may have local adverse effects on marine life due to entrainment, entrapment and thermal "shock." Enhanced sport fishing and possible aquaculture opportunities may offset these. For at least the number of plants anticipated by 1990, fishery damages and thermal discharges are not anticipated to have an effect on the Sound as a whole. Nuclear plants present at least a theoretical risk of radiation leaks, but chances are considered extremely slight. Disposal of their radioactive wastes could cause serious adverse effects if not properly stored for their radioactive lifetime of over 200,000 years. Some adverse health and aesthetic effects would be caused by air pollution from oil or coal burning plants. All of these facilities, as well as cooling towers, would have adverse visual effects, and cooling towers can have adverse effects on weather as well. All of these impacts can be minimized through strict energy conservation programs, which could result in the postponement of several plants until less environmentally impactful forms of power generation are available (see 2.7 Power and the Environment).

Sand and gravel mining. Sequential land use will produce severe, immediate, and local disruption in the vicinity of sand and gravel extraction sites. The environmental impacts, however, are temporary, since statewide standards and uniform regulations would require reclamation and restoration of each site so used. Reclamation of Port Washington sand pits has uniformly favorable environmental impacts by providing park land where open sand pits and refuse areas are now located. Marine mining may have adverse environmental effects in the immediate vicinity of sand mining operations, by destroying shellfish beds and fallout of fines on immediately adjacent areas. Feasibility study is recommended to determine these impacts. Maintenance of rail distribution links has beneficial environmental impacts by reducing reliance on truck transportation. Restoration of abandoned sites has uniformly beneficial environmental impacts (see 2.9 Mineral Resources and Mining).

Flood damage reduction. Flood insurance, regulation of land use, flood proofing, and public education generally have beneficial environmental impacts in the flood plain, where development is discouraged, but some consequent adverse environmental impacts in those areas outside the flood plain where development is encouraged to relocate. In terms of total acreage, relocation of development in the Long Island Sound region can be expected to consume *more acreage* than if it were encouraged to remain in the flood plain. However, in terms of *environmental value of acreage,* this increase is expected to be offset by protection of flood prone areas, wetlands, and consequent preservation of wildlife, flood buffering, scenic preservation, and open space. The riverine flood control projects are not considered by local and state interests to have significant adverse environmental effects. While some cold water fish species might be damaged, other warm water species would be benefitted (see 2.10 Flood Damage Reduction).

Coastal erosion recommendations will permit the natural environmental succession to continue in all areas except a limited number of public bathing beaches, where beach nourishment and retention structures are recommended. Some alteration in the natural erosion of bluffs in the lee of the retention structures can be expected, and removal of sand from deepwater areas for deposit on the beaches will have local adverse impacts on any shellfish beds in the vicinity of removal. Upland erosion control measures are all in the nature of requiring landscaping, contouring, and other measures to diminish the effects of construction and accelerated runoff from increased development. Environmental impacts are lowered stream siltation and retention of topsoil. There are no adverse effects expected (see 2.11 Erosion and Sedimentation).

Alternatives to the Proposed Action

The Study Management Team studied, developed, and described appropriate alternatives to the recommended plan of action in each subject area. A summary of the alternative plans considered is described below.

Water Quality. One alternative, to restore shellfishing throughout the Sound, was eliminated because of economic considerations. Another plan omitted combined sewer separation, combined sewer overflow treatment, and wastewater recharge on economic grounds, but was not recommended (see 2.1 Water Management).

Land Use. The major alternatives considered were degrees of control over concentrations of growth; alternatives to dispersed commercial, industrial, and residential centers; continued reliance on automobile transportation; and other measures which would consume vastly greater amounts of open space and subject many new areas to paving, and would further disperse pollution sources. This alternative was eliminated for environmental reasons (see 2.2 Land Use

and Growth).

Recreation. An environmental preservation alternative relied on extensive use of open space on the shorefront, extensive public marinas and boat rentals, not building artificial islands, and more strongly favoring mass transportation. Another alternative, emphasizing the economic development objective, emphasized intensive use of all open space on the shorefront and accommodating all boating demands, regardless of impact on fragile resources and congestion created. This alternative was rated poor for environmental and social reasons (see 2.3 Outdoor Recreation).

Sport Fishing and Wildlife. Alternatives involved lowering standards for water quality improvement, less preservation of wetland areas, and no acquisition of islands. An alternative plan emphasizing environmental quality eliminated recommendations for increased fishing access, but required pollution control adequate to restore shellfishing throughout the Sound. This latter was eliminated on economic grounds as being completely beyond economic feasibility (see 2.4 Sport Fisheries and Wildlife).

Marine Transportation. One alternative eliminated all marine petroleum handling in Long Island Sound, replacing it by a pipeline from outside the region. Also included in the environmental quality plan was improvement of cross-Sound ferry service only at mid-Sound. Another alternative took the opposite approach: maintain and improve channels, increase the number of offshore berths, drop the requirement for consolidating storage, leave tanks at shore, and allow free expansion of the existing people transportation system (see 2.6 Marine Transportation).

Electric Power. One alternative would take advantage of the cooling water resources in the Service Area, and study area in particular. In such a plan, the Service Area would become a net exporter to the larger Market Area. Environmental constraints on facilities siting and operation would be minimized. In the environmental quality plan, however, environmental safeguards would be so strict that it would be more economical for the Service Area to become a net importer of power (see 2.7 Power and the Environment).

Commercial Fishing. One plan emphasizing environmental quality would eliminate such measures as expanding the shellfish industry, establishing port landing facilities, reevaluating commercial fishing regulations, and providing assistance to the shellfish industry. Another alternative favored all measures which enhance opportunities for expanding the shellfish industry (see 2.8 Commercial Fishing).

Sand and Gravel Mining. One alternative emphasized environmental quality by relying on importation of sand, gravel, and stone from outside the region, and reduction or elimination of sand and gravel extraction in the region. This was eliminated on economic grounds, and as unnecessary on environmental grounds since, for a small additional cost, sand and gravel can be removed while preserving air, water, and land quality. Another plan emphasized economic efficiency by stressing the use of mineral deposits close to the point of consumption with little environmental protection, such as reclamation of mined out lands. This alternative was eliminated on environmental grounds (see 2.9 Mineral Resources and Mining).

Flood Damage Reduction. An environmental quality alternative emphasized land use regulations, control of land runoff, and use of conservation oriented government programs. It reduced the number of tidal and riverine flood control projects to five and nine respectively, emphasized flood proofing, forecast warning and evacuation services, and emergency assistance. It eliminated weather modification. Another alternative emphasized flood control structures, but rejected educational and financial policies, land use regulations and flood insurance as having a low benefit/cost ratio (see 2.10 Flood Damage Reduction).

Erosion and Sedimentation. One alternative stressed environmental quality by regulating land use and eliminating all structural controls. Another plan, stressing economic efficiency, maintained existing erosion control structures, dredged channels, and did not discourage the use of groins and jetties to retard erosion (see 2.11 Erosion and Sedimentation).

More details on each of these alternatives can be found in the body of the main report, and in the supplementary planning reports issued by this study.

Relationship between Local Short-term Uses of Man's Environment and the Maintenance and Enhancement of Long-term Productivity

The cumulative and long-term impact of the recommended plan has been specifically designed to insure that those resources contributing to the quality of man's life and environment are safeguarded for succeeding generations. The land use plan adopted as the basic framework for planning directs future growth into specific geographical locations. This principle of concentration, while offering the greatest opportunity for successful economic development, places major urban and economic activities away from environmental or open space areas which are preserved. This minimizes the acreage that would be developed for urban needs and other uses. All water quality recommendations are designed to increase future uses of the Sound, maintain biological productivity and species diversity, and generally increase options. Short-term impacts on municipalities and industries will be offset by long-term enhancement of the environment, and will encourage business and residential communities to stay or locate into the region. The recreation recommendations would have an impact on long-term productivity, because in areas where mass recreation facilities are provided, vegetation and wildlife would be suppressed. However, the nature of recreation development is such as to allow the reclamation of these areas for biologically productive uses in the future, should it become necessary. Most other recreation proposals have

the effect of preserving areas for open space and thus enhancing the opportunity for future agricultural or other productive uses of the land and water. The fisheries and wildlife recommendations are all intended to maintain biological productivity, species diversity, preserve areas for wildlife breeding and propagation, and hence will enhance future productivity. Shoreline appearance and design recommendations, such as preserving scenic vistas and viewpoints and encouraging better design of what shoreline development is permitted, will also preserve open space and enhance long-term productivity. The marine transportation recommendations such as port consolidation and increased reliance on pipelines have no significant impacts in this respect. The electric power recommendations will increase the total thermal load on Long Island Sound, and hence will alter the ecological balance to a small but indeterminate degree. It is unknown whether this will enhance or retard long-term productivity, and there is no conclusive evidence one way or the other. The production of adequate amounts of inexpensive electric power, however, will have beneficial environmental effects by easing the implementation of such energy consuming advanced pollution control processes. The sand and gravel recommendations are all oriented toward preserving areas for mineral production, and then restoring the sites to other uses. In the few areas where flood control structures are recommended, long-term productivity can be expected to change from terrestrial and wetland habitats to aquatic or upland habitats. This would lower long-term productivity in these areas, but in those areas where relocation of development from the flood plain is recommended, returning the area to a natural condition and allowing natural environmental factors freer play can be expected to compensate. The erosion and sedimentation recommendations, by retaining more valuable top soil on the land, will increase long-term productivity there and improve water quality for fish and shellfish propagation. Natural siltation will continue to preserve the productivity of oyster beds.

There is a general emphasis on the reuse and recycling of resources throughout the plan, such as recharge of wastewater on Long Island. On balance, by organizing man's activities to make them more economically efficient, the plan will improve the productivity of the natural environment as well.

Irreversible and Irretrievable Commitments of Resources which Would be Involved in the Proposed Action Should it be Implemented

None.

Discussion of Problems and Objections Raised by Other Federal, State, and Local Agencies and by Private Organizations and Individuals in the Review Process and Disposition of the Issues Involved

See below, Reviewing the Plan.

Reviewing the Plan

The following is a summary of major reactions to the draft plan for Long Island Sound and the draft Environmental Impact Statement by members of federal, state, and interstate agencies, local governments, citizen groups, and individual citizens.

Review and comment on the draft plan for Long Island Sound and the draft Environmental Impact Statement by the general public and representatives of all levels of government throughout the region took place during a 90-day review period between November 12th, 1974 and February 18th, 1975. To implement this review process, the following measures were taken:

- A series of eight public meetings were held on weekday evenings during the month of January.
- Fifteen thousand copies of a twenty-page newspaper summarizing the recommendations of the plan were distributed throughout the region.
- Twenty-five speaking engagements were filled by members of the staff to groups ranging from twenty-five to one hundred persons.
- 450 copies of the draft main report were distributed to local, county, regional planning, state, inter-state, and federal officials as well as fifty libraries, thirty citizen groups, and twenty senators and congressmen.
- Copies of the draft main report and the draft Environmental Impact Statement were provided to the Council on Environmental Quality, and a summary of the draft Environmental Impact Statement was printed in the December 3, 1974 edition of the *Federal Register.*
- 450 letters were received and responded to regarding the draft plan and draft Environmental Impact Statement.
- Oral public testimony at the eight public meetings was tape recorded and summarized in minutes of each.

During the two months following the close of the 90-day review period, the staff of the Long Island Sound Study reviewed each of the comments received and revised the draft plan and the draft Environmental Impact Statement preparatory to final publication, in the light of these review comments. It should be noted that the minutes of all public meetings, copies of prepared testimony submitted at those meetings, and copies of all correspondence received during the public review period, have been submitted under separate cover to the U.S. Water Resources Council for transmittal to the Council on Environmental Quality. In addition, tapes of all eight public meetings are on file at the offices of the New England River Basins Commission, 55 Court Street, Boston, Mass.

Following is a summary of what the staff believed to be the most significant comments on the draft plan and the draft Environmental Impact Statement, together with a description and sampling of those making the comment and a staff response to that comment.

Major Comments on the LISS Draft Plan and Draft Environmental Impact Statement

1. *Subject: Overall Plan*
   Public and official response to the overall Draft Plan was overwhelmingly positive. The great majority of criticisms stemmed from:
   (a) misunderstanding of recommendations, often as they were presented in the Summary, and
   (b) problems with the tone and style of presentation, in the Summary and throughout the main report (HUD, USDOI, various public and local officials).
   LISS Response:
   (a) Revised main report and Summary, to add specifics and clarify confusing sections. See especially the Plan Summary and Sections Two and Four of the Plan Supplement.
   (b) Edited and reorganized to achieve some evenness of style. Note particularly reorganization of the Plan Summary and Section One of the Plan Supplement. Made minor editorial changes throughout.

2. *Subject: Lack of a Sense of Strategy*
   This general response was expressed in a great number of

official and public comments. Three components of a strategy for implementing the Plan's recommendations were noted by many to be missing:

(a) *Priorities*– should be set between individual recommendations and among functional categories of recommendations (ERDA, EPA, NYS, various public, local officials).

(b) *Dates*– more detail needed on scheduling, timetables for implementing recommendations, to indicate relative urgency and help prioritize recommended actions (NED-ACOE, NYS, various public, local officials).

(c) *Costs*– need for more cost/benefit data on implementation of individual recommendations; sets of recommendations, such as water quality clean up program; and overall plan (USDA, USDOC, ERDA, NED-ACOE, NYS, various public, local officials).

LISS Response:

(a) Revised "Plan Highlights" section of Summary, setting priorities among recommendations; added "Chapter Highlights" (priorities boxes) to chapters of Summary (each chapter contains several functions).

(b and c) Summary: Inserted dates and cost figures in "Plan Highlights", and for major program elements, throughout text of Summary, where the study deemed it reasonable and appropriate to do so; Main Report: Described general cost feasibility of recommended water quality improvement plan (Section 2.1); clarified relationship of Plan to planning reports, and the cost data available there.

3. *Subject: Long Island*

(a) A number of commentors expressed the view that more of Long Island should have been included in the LISS region (various public).

(b) More consideration should be given to the unique and complex interrelationships of wastewater disposal and water supply on Long Island (various public and local officials).

LISS Response:

(a) At the request of Nassau and Suffolk Counties and the Governor of the State of New York, and by Executive Order of the President of the United States, the study region on Long Island was designated to be coterminous with the hydrologic boundaries.

(b) Long Island's unique and complex ground water management problems are discussed in Section 2.1 Water Management, to the degree that these issues directly affect the Sound. The plan does not explore these problems in depth, however, because they extend well beyond the boundaries and scope of this study, and because they are the primary focus of several other major studies.

4. *Subject: Areawide Water Management*

Specific reference should be made to "208" planning (HUD, CT. DEP, NYS DEC, local officials and public).

LISS Response:

Incorporated "208" planning into discussion of area wide water management programs in Section 2.1 Water Management, Subregional sections, and Summary.

5. *Subject: High Quality Areas*

Give emphasis to importance of protecting high quality waters and water-related lands, e.g. expanding non-degradation zones (EPA, Connecticut Department of Finance and Control, various public and local officials).

LISS Response:

Expanded discussion of water-related lands preservation versus development, in Section 2.2 Land Use and Growth; augmented "Vessel wastes" recommendation to provide additional non-degradation zones, in Section 2.1 Water Management; added to list of suggested non-degradation areas, in Section Three: The Plan by Subregion; included non-degradation zones as high priority in "Plan Highlights" and "Water Highlights" (Summary).

6. *Subject: Combined Sewers*

Combined sewer pollution should be abated by the separation of storm and sanitary sewers rather than storage of overflows and subsequent treatment (CT. DEP, various local officials).

LISS Response:

The plan points out that sewer separation by itself will probably not achieve acceptable water quality standards, due chiefly to the fact that storm water runoff is itself heavily polluted and would probably have to be treated in order to meet acceptable water quality standards. This conclusion is based on recent EPA studies. In view of this, the study recommends a program which would separate some sewers but rely primarily on other facilities for regulating, storing and treating overflow—at a great deal less cost than the cost of complete sewer separation alone. The plan proposes that such a comprehensive program be entered into in stages, utilizing the best combination of techniques from the many available to suit each particular situation.

7. *Subject: Vessel Wastes*

On board treatment devices are preferable to holding tanks/pump-out facilities (various public and local officials).

LISS Response:

Modified holding-tank recommendation to include possibility of developing new technology for zero discharge device; updated to correspond with recent Coast Guard regulations (issued during 90-day review of the "draft" plan); added areas where boats and swimmers congregate as potential no-discharge zones. See Section 2.1 Water Management.

8. *Subject: Growth*

Need more detailed attention to the issue, implications of growth (various public and local officials).

LISS Response:

Decisions about limiting growth are beyond the purview of the study; however, inserted general discussion on prospects for guiding growth into Section 2.2 from Land Use planning report; discussion of growth in Summary with material from Section 2.2; retitled and repositioned Land Use and Growth in the Summary, to clarify its relationship to the rest of the Plan.

9. *Subject: Access*

(a) Significant increase in access to the Sound will cause impacts running counter to water quality goals, for which a great deal of money is recommended to be spent (various public and local officials).

(b) Private beach property should not be taken by eminent domain by either the states or by local governments (various public and local officials).

LISS Response:

(a) Fundamentally inequitable to spend large amounts of federal money cleaning up the Sound if access is restricted to relatively few who now enjoy free access. If the people whose money is spent in clean-up cannot use the Sound, why clean it up with public funds? With increased access must come improved management, so that gains in improved water quality, protected wildlife, open space acquisition, environmental protection, are not offset by uncontrolled public access. Where environmental considerations dictate lower level of activity, access should be controlled—however, not exclusively on the basis of ability to pay.

(b) States have powers of eminent domain and have used them in the public interest, for the building of various public facilities. They have not used them very actively to meet the demand for and alleviate the shortage of recreational facilities. Where private rights are thought to outweigh the public good, citizens can effectively stop the use of eminent domain. Where it is thought to serve the public good, eminent domain will be an acceptable method of meeting the public need for recreation on the shores of LIS.

10. *Subject: Recreation Funding*

(a) Concern or objections to alterations to the Land and Water Conservation Fund (BOR, CT.).

(b) Drop 75 percent of Heritage Funding or explain why in context of wealthy bordering counties (BOR).

(c) Most state and federal funds do condition public access; why reaffirm? Identify exceptions (BOR, CT., NYS).

LISS Response:

(a) Deletion of all references to the Land and Water Conservation Fund in recommendation.

(b) Have prefaced Heritage recommendation with rationale.

(c) See no point in singling out exceptions to general current practice. We simply call for reaffirmation.

11. *Subject: Recreational Boating*

(a) Disagreement with a number of private potential sites listed. Examples include Niantic River, Wescott Cove, and Little Neck Bay (local officials and public).

(b) Absence of a recommendation in the recreation chapter which is listed in Section Four's "Index for decision makers": small harbor studies (COE).

LISS Response:

(a) Deleted specific numbers for developed facilities at Niantic River; drop Wescott Cove; include Little Neck Bay.

(b) Inserted recommendation in recreation chapter.

12. *Subject: Artificial Island*

(a) Much more detailed study—particularly of environmental impacts—would have to be done (HUD, NYS, NYC, BOR, local officials).

LISS Response:

Recommend detailed feasibility and environmental impact study before proceeding. Still cite *approximate* location.

13. *Subject: Heritage*

There appeared to be substantial support for the Heritage recommendation, expressed by a great number of commentors at the public meetings and in correspondence. The details of certain site-specific proposals were criticized, most notably in the case of Sound View in Connecticut.

(a) Enthusiastic support for Heritage concept (various citizens and local officials).

(b) Opposition to some components of the Heritage: Bluff Point, Ram Island, Rocky Neck S.P., Sound View, Menunketesuck Island, Lighthouse Pt. Park, Pleasure Beach, Caumsett S.P. (CT. DEP, various public and local officials).

LISS Response:

Balance must be drawn between access and protection; need for further study, more detail on site capacities implicit in all recommendations. Specific proposals:

Bluff Point– made more specific references to portions to be developed for recreational use and portions to remain undeveloped;

Ram Island– toned down proposed development, deleted recommendations for intensive swimming facility;

Rocky Neck– specified annexation of undeveloped portions of Niantic State Farm, with buildings on the site to "be put to some appropriate re-use";

Sound View– dropped proposal—too expensive and disruptive;

Menunketesuck Island– dropped proposal—impracticable, inappropriate use of this site;

Stony Creek Quarry/Faulkner's Island– new Heritage proposal, for casual recreation;

Lighthouse Point Park– modified proposal, describing the area and schedule for acquisition more specifically, adding a "Classroom by the Sound" field lab, recommending 0.5 instead of 1.5 mi. of beach;

Pleasure Beach– clarified proposed use of Green Meadow, kept recommended acquisition, added restricted recreational use during Least Tern nesting season;
Port Washington Sandpits– see specific comment later;
Caumsett– modified proposal, recommended development by 1980 instead of 1978, clarified details of development, with "preservation and appropriate re-use of the buildings," added development of mini-bus service from parking facilities.

14. *Subject: Recreational Ferries*
(a) Generally supported (various public, local officials).
(b) Further study needed, e.g. economics, routing, mass transport linkages, environmental impact of increased access (NYS Office of Parks and Recreation, various public and local officials).
(c) Objections to specific routes.
LISS Response:
Function of ferries is to limit and control access, to improve management of recreational areas, in contrast with present unmanaged, unregulated system of access. Added language to this effect in 2.3 Outdoor Recreation. Modified ferry routes, deleting New London/Groton, Old Saybrook, South End, and Northport stops, replacing Orchard Beach Island with Caumsett State Park. Need for further detailed study and cost/benefit analysis implicit in this, as all recommendations–now made clear on inside cover of report.

15. *Subject: "Super Tankers", Oil Refineries, "OCS" Development, and Offshore Berths*
These issues aroused strong comments on the part of numerous private individuals, citizens and environmental organizations, such as the Connecticut Citizen Research Group, and the Study's Citizen Advisory Committee. The view shared by the overwhelming majority was to limit size of petroleum-laden vessels permitted in the Sound.
LISS Response:
Added new recommendations to 2.6 Marine Transportation: "Limit tanker size, require developers of offshore berths to file environmental impact statement with specific vessel information. In no event should tankers larger than 150,000 dead weight tons or drawing more than fifty-five feet be permitted in Long Island Sound." Emphasis of Plan is port consolidation, thus to phase out small tankers, not increase size of large ones entering Sound.

16. *Subject: Once-through Cooling*
More attention should be given to the effects of once-through power plant cooling on the Sound, such as impingement, entrainment, and thermal additions (EPA, NYS, CT. DEP, various public).
LISS Response:
Added recommendations urging support and encouragement of research into effects of once-through cooling; description of EPA thermal regulations.

17. *Subject: Nuclear Power*
Some industry officials and private citizens commented favorably on the recommendations in the Draft Plan to provide all or most base load additions in this area with nuclear facilities, at least until 1990 or until suitable new forms of energy production become available. However, these were far outnumbered by the responses by private individuals, environmental groups, and government officials, expressing opposition to further development of nuclear facilities in this region. The themes of most comments were:
(a) Concern about public safety and environmental impacts associated with nuclear power generation (HUD, NYS, local officials, various public).
(b) More emphasis should be given to energy conservation and alternative sources of power (NYS, local officials, various public).
LISS Response:
(a) Some further development of pros and cons, expanded discussion of nuclear power in Summary; basic conclusions unchanged. Reference NYS regulations governing power plant siting and electric transmission, in Section 2.7 Power and the Environment; preface "reliance on nuclear energy" recommendations with acknowledgement of potential problems, conditioning recommendation on satisfactory resolution of questions about nuclear safety, which are current subjects of research.
(b) Special emphasis on *conservation of energy,* with brief rationale for giving this recommendation *highest priority.*

18. *Subject: Port Washington Sandpits*
(a) Funding for reclamation project may not be available from specified agencies (HUD, USDOI-BOM).
(b) Emphasis of reclamation should be as recreation/open space opportunity (local officials and public).
LISS Response:
Revised recommendation:
(a) Deleted designation of USBOR and HUD as sources of funds and technical assistance.
(b) Incorporated into LIS Heritage, with emphasis on shorefront recreational opportunity, *possible* non-recreational uses along western boundary and interior.

19. *Subject: Erosion Control*
Give more attention to coastal erosion control, alternatives to accepting continued damages (NYS DEC, public).
LISS Response:
Added recommendation to encourage research into wave energy dissipation systems, demonstration program.

20. *Subject: Environmental Impact Statement*

(a) Section Five *alone* does not substantially satisfy NEPA and CEQ requirements (USDOI, USDOC, USDA, ERDA).
(b) Section Five is adequate for planning document; complete EISs would be required at implementation stage of each of significant actions (EPA, FPC, N.H.).
LISS Response:
The beginning of Section Five: Evaluating and Reviewing the Plan now contains information indicating that the present environmental impact statement is of a type known as "broad program statement", and also that the entire main report within which the EIS chapter is embodied constitutes the more detailed environmental impact information required. Cross references have been added to the EIS throughout. In addition, examples of evaluation matrices for alternative measures, including environmental criteria, have been included from the functional planning reports. Section Five has been updated to reflect revised recommendations throughout the main report.

Many of the actions are nearly impossible to evaluate until the further detailed studies are performed. For example, the recommendation to establish coastal zone management planning, which itself will embody environmental impact analysis, may or may not have deleterious environmental impacts, depending on how it is administered. The supposition is, of course, that the effects will be beneficial.

The decision to list "none" under the section of the Environmental Impact Statement entitled Irreversible and Irretrievable Commitments of Resources was a conscious one. Each of the recommendations was reviewed in light of the irreversibility criterion. None was discovered which were in whole or part irreversible, including structures in the flood plains which would alter the hydrologic configuration, etc. The study staff raised grave questions as to the meaning of the criterion, and recommended that future guidelines for Environmental Impact Statements more clearly define its meaning.

21. *Subject: Super Agency*
No new super agency, e.g. bi-state commission, should be created to regulate the Sound region (local officials and public).
LISS Response:
Agree with principle. Selective additions to Section Four to clarify the fact that we are not recommending a super agency. Summary, Section Four: modified tone of presentation.

22. *Subject: Local Involvement*
Local involvement in coastal planning was a very sensitive issue to most of the Connecticut and New York towns bordering on the Sound, where home-rule is a long and cherished tradition. A number of letters and comments at the public meetings expressed the importance of protecting strong local powers in the coastal zone. Support for the study's regional approach to shoreline management was also expressed by citizens, planning and environmental groups, and some private individuals.
(a) Strong local participation in coastal zone management is essential, e.g. local enforcement of state regulations (CT. Coastal Area Management Program, various local officials and public).
(b) Local control over development with region-wide impacts has been too powerful in the past; other interests must be represented in the coastal management process (various local officials and public).
LISS Response:
Agree that local input is extremely important in coastal planning process, although local interests must sometimes be balanced against regional impacts. "Delegate agencies" have been renamed "intermediate agencies." The coastal zone management proposal in Section Four spells out a strong role for local communities, including preparing coastal plans, providing local participation in the intermediate agency, and certain provisions for a local override of intermediate agency actions. To respond to this point further, we have clarified and emphasized the local composition of the intermediate agencies.

23. *Subject: Delegate Agencies*
Shoreline regional planning agencies are not presently suited to be empowered as "delegate agencies" for coastal zone management in Connecticut (HUD, CT. Coastal Area Management Program, local officials in CT.).
LISS Response:
Section Four acknowledges that the CT. RPA's do not possess the necessary authority to perform the role spelled out for them in the proposal, and that new authority would be necessary. To further explain why the RPA's were chosen, we added material identifying the characteristics of the "delegate agency," added criteria for the selection, and gave added consideration to other possible alternative choices such as the regional councils of government or the regional councils of elected officials. To reflect the local representative nature of these agencies, we changed their reference to "intermediate agencies."

24. *Subject: Interim vs. Long Range Management*
The relationship between the interim and long range management programs and the states' coastal zone planning efforts should be clarified (HUD, CT. DEP, CT. Coastal Area Management Program).
LISS Response:
Agree, although difficult to spell out. One of the major links between the interim and long range programs is the possibility of the interim program to develop into the permanent mechanism for bi-state coordination once the states' longer range management programs are

set up. Added language in Section Four to this effect.

25. *Subject: Coastal Zone Boundaries*
Additional consideration should be given to the identification of boundaries in the coastal zone (NOAA-NOS, local officials and public).
LISS Response:
Agree in principle. Clearly, one of the major responsibilities of the state efforts in their coastal zone management and planning programs will be the accurate identification of the coastal zone, and they have begun to do this. Discussion in Section Four states explicitly that we are using that definition only for illustrative purposes and that other definitions are possible.

Appendix

Long Island Sound Study Reports

This list includes reports and papers published by, closely affiliated with, or funded by the Long Island Sound Study.

Major LISS Reports

1. *Main Report* of the Long Island Sound Study, two volumes, the Summary and the Supplement, June, 1975.

2. *Planning Reports*–June, 1975.
   Land Use, Ralph M. Field and Associates for the U.S. Dept. of Housing and Urban Development.
   Water Management, U.S. Environmental Protection Agency, and the States of New York and Connecticut.
   Shoreline Appearance and Design, U.S. Department of Interior, National Park Service, and Roy Mann Associates.
   Erosion and Sedimentation, U.S. Department of the Army, Corps of Engineers, and the U.S. Department of Agriculture, Soil Conservation Service.
   Flood Damage Reduction, U.S. Department of the Army, Corps of Engineers, and the U.S. Department of Agriculture, Soil Conservation Service.
   Outdoor Recreation, U.S. Department of Interior, Bureau of Outdoor Recreation.
   Fish and Wildlife, U.S. Department of Interior, Fish and Wildlife Service, and U.S. Department of Commerce, National Marine Fisheries Service.
   Marine Transportation, U.S. Department of the Army, Corps of Engineers.
   Mineral Resources and Mining, U.S. Department of Interior, Bureau of Mines.
   Power and the Environment, Federal Power Commission staff.

3. *Shoreline Appearance and Design: A Design Handbook;* prepared for the National Park Service by Roy Mann Associates, June, 1975.

4. *An Economic Perspective;* prepared by the U.S. Department of Agriculture, Economic Research Service, and the U.S. Department of Commerce, Bureau of Economic Analysis, July, 1974.

Other LISS Reports

1. "Proposal for a Study Leading to a Comprehensive Plan For the Water and Related Land Resources of Long Island Sound," New England River Basins Commission, October, 1970.

2. *Plan of Study,* August, 1971.

3. *Bibliography for Planning,* May, 1973.

4. Interim Reports:
   Electric Power Generation, July, 1973.
   Mineral Resources and Mining, July, 1973.
   Soils, September, 1973.
   Sources and Movement of Water, October, 1973.
   Recreation, October, 1973.
   Flood Plains, October, 1973.
   Erosion and Sedimentation, October, 1973.
   Scenic and Cultural Resources, January, 1974.
   Ecological Studies, February, 1974.
   Water Supply, February, 1974.
   Water Quality, March, 1974.

5. Record of Public Workshops and Hearings:
   A. Summary of Public Meetings of April and May, 1974.
   B. Public Survey Questionnaire Results; July, 1973 and June, 1974.
   C. Minutes and Prepared Statements of Public meetings, January, 1975.

6. "Planning to Save Our Sound:" papers prepared for public workshops, May, 1973.

7. *Urban Sea,* Long Island Sound Study Newsletter:
   No. 1. Summer, 1973.
   No. 2. "How the Study Stands Now," Fall, 1973.
   No. 3. "Toward a Plan for Long Island Sound," Spring, 1974.
   No. 4. "People and the Sound: Draft Plan for Long Island Sound," Fall, 1974.

Associated Reports and Papers

1. *Congressional Hearings: Preserving the Future of Long Island Sound*
   Hearings before the Subcommittee on Executive Reorganization and Government Research of the Committee on Government Operations, United States Senate, S. 2472:
   Parts 1–3, July, 1970
   Part 4, October, 1971
   Part 5, March, 1974

2. *Goals for the Region,* Citizens' Advisory Committee; November, 1973.

3. *Research/Planning Advisory Committee Papers:*
   September 13–14, 1973: Economics, Tidal Wetlands, Electric Power, Recreation, Food Production, Geology, Terrestrial Ecosystems, Marine Ecosystems, Land Use, Transportation, Use Policies, Natural Characteristics.
   October 8–9, 1973: Water Pollution, Electricity Demand, Transportation, Salt Marshes.
   January 3–4, 1974: Urban Poverty, Land Use, Water Supply, Mining, Wetlands, Fishery Management, Electric Power, Flood Plains, Land Transportation, Ecology of the Region, and Water Quality.

4. *Legal and Institiutional Framework for Long Island Sound Management,* prepared for Long Island Sound Regional Study by Raymond, Parish, and Pine, Inc., November, 1974.

5. "Legal and Institutional Memoranda" prepared for the Long Island Sound Regional Study by Sosnoff, Cooper, and Whitney, Esq. (a); Cogen, Holt, and Associates (b); and Russell Brenneman, Esq. (c):
   1. *Salt Water Fishing Licenses,* May, 1974 (c)
   2. *Subsidization of Commercial Fishermen,* May, 1974 (c)
   3. *Streambelt Protection,* May, 1974 (a)
   4. *State Regulation of Mining,* May, 1974 (c)
   5. *Marine Mining,* May, 1974 (c)
   6. *Sequential Use of Mineral Extraction Lands,* May, 1974 (c)
   7a. *Park & Beach Access,* May, 1974 (b)
   7b. *Increased Public Access to Publicly-Owned Land,* May, 1974 (a)
   8. *Tax Abatement on Private Outdoor Recreation Facilities,* May, 1974 (a)
   9. *Recreational Use of Watershed Lands,* May, 1974 (a)
   10. *Public Recreation Access to Public Utilities Along the Shore,* April, 1974 (b)
   11. *Advanced Non-Specific Land Acquisition,* June, 1974 (c)
   12. *State Override Powers,* June, 1974 (b)
   13. *Innovative Zoning,* May, 1974 (c)
   14. *Special District Zoning,* May, 1974 (a)
   15. *Land Profit Tax,* May, 1974 (c)
   16. *Environmental Criteria for Land Use Regulation,* May, 1974 (b)

6. *Artificial Islands and Platforms in Long Island Sound,* prepared for the Long Island Sound Regional Study by John McAleer, June, 1974.

7. *Land Use Inventory Report,* prepared for the Department of Housing and Urban Development by Ralph M. Field, February, 1974.

8. "Outdoor Recreation and Long Island Sound," a series of planning aide reports prepared for the Long Island Sound Regional Study by the Bureau of Outdoor Recreation:
   1. *Review of Plans and Studies,* 1972
   2. *Recreation Demand Methodology,* February, 1973
   3. *Demand, Supply, Needs,* June, 1973
   4. *Resource Potential,* August, 1973
   5. *Accessibility,* December, 1973
   6. *Multi-Purpose Use of Public Facilities,* August, 1973
   7. *Efficient Use of Recreation Properties,* January, 1974
   8. *Alternatives to Shoreline Recreation,* March, 1974
   9. *An Urban Prospectus and Bridgeport Case Study,* April, 1974

9. *Transportation Inventory/Land Based Transportation System,* prepared by Wilbur Smith and Associates for U.S. Army Corps of Engineers, March, 1974.

10. *Environmental Baseline in Long Island Sound 1972–1973,* prepared by the National Oceanic and Atmospheric Administration and the National Marine Fisheries Service, Northeast Region, December, 1974 (two volumes).

11. *Tidal Wetlands of Connecticut,* two volumes prepared by Connecticut Department of Environmental Protection (William A. Niering and R. Scott Warren, Consultants) for the Fish and Wildlife Service.
    Volume 1, *Tidal Wetlands of Connecticut, Vegetation and Associated Animal Population,* January, 1974.
    Volume 2, *Tidal Wetlands of Connecticut, Vegetation and Microrelief,* February, 1975.

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